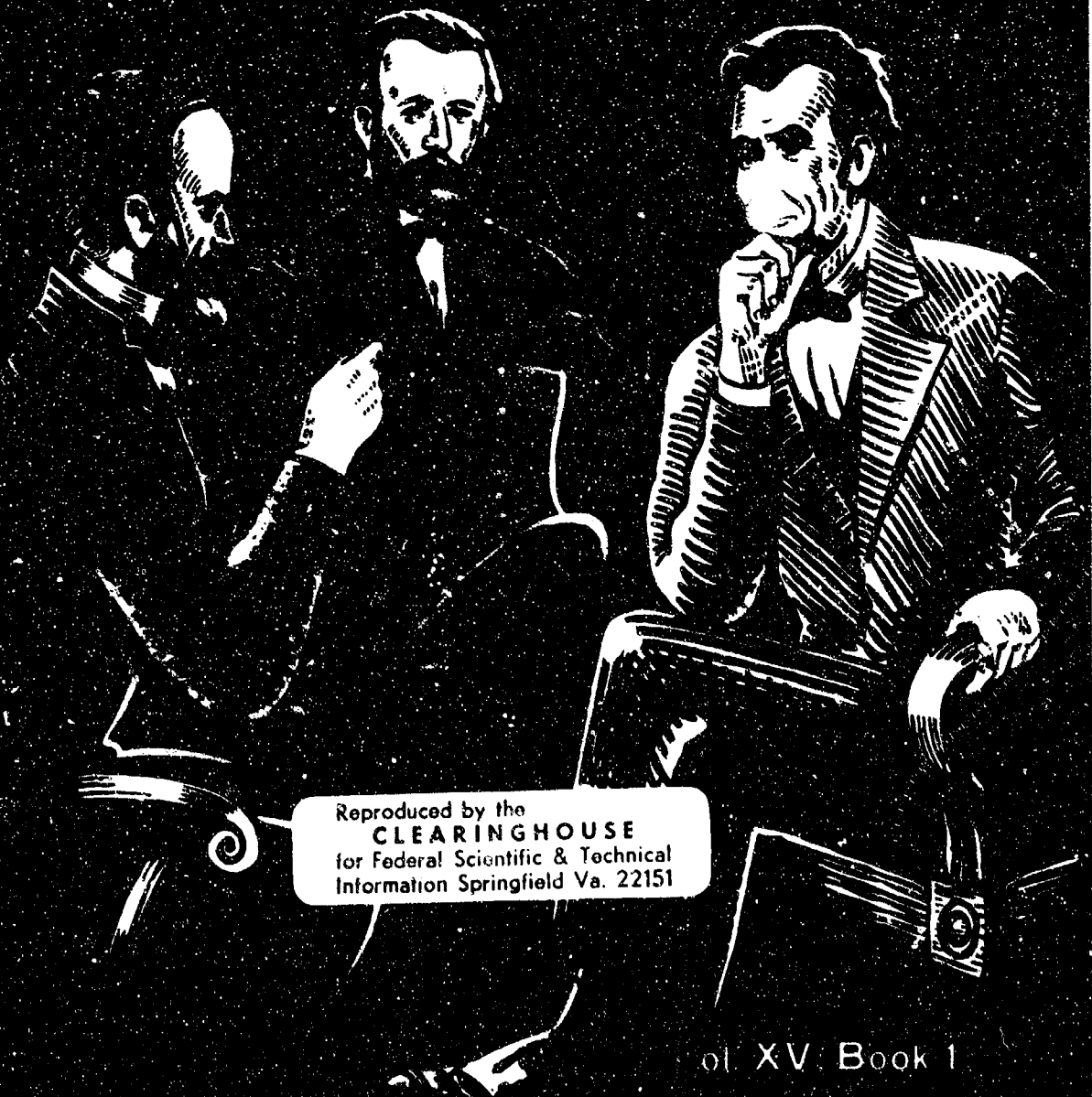


# Army Management Views

U.S. Army Management School  
Fort Belvoir, Virginia



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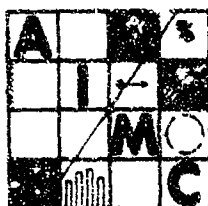


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# **ARMY MANAGEMENT VIEWS**

Edited by  
**CHARLES W. DAHLGREN,**  
Director, Office of Plans & Research,  
and **MURRAY SUMMERS**

## **VOLUME XV BOOK 1**

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Published March 1970



# FOREWORD

COLONEL JOHN R. MCLEAN

COMMANDANT,

U. S. ARMY MANAGEMENT SCHOOL

We are deeply indebted to the many outstanding managers, both within the Army establishment and outside it, who regularly take the time to address the participants of our three courses — the Army Installation Management Course, the Operations Research/Systems Analysis Executive Course, and the Defense Family Housing Management Course. We are proud to be able to have several of those managers represented in this edition.

Some speakers whose presentations are in this issue were appearing for the first time at our rostrum. Their fresh ideas, new approaches, and enthusiastic participation are also most significant contributions to our courses. We appreciate their efforts too.

It is our hope that the publication of these representative addresses by our guest speakers will provide a valuable service in extending the school's continuing dialogue on modern management problems and practices to many other personnel concerned with obtaining better utilization of limited resources through improved management.

February 1970

JOHN R. MCLEAN  
Colonel, FA

## PREFACE

MR. CHARLES W. DAHLGREN  
DIRECTOR, PLANS AND RESEARCH  
U. S. ARMY MANAGEMENT SCHOOL

This edition of *Army Management Views* (Vol. XV, Book 1) offers articles on a wide variety of managerial techniques ranging from mathematical programming to creative problem solving. Persons interested in management science please note that this edition contains eight operations research/systems analysis-related articles which may be found in Section V.

Students of general management will find several interesting articles in their field in Section I, led off by Dr. Koontz's thought-provoking article.

The articles by Messrs. Gieck and Knott afford an opportunity to make some interesting comparisons between installation management and industrial management.

February 1970

CHARLES W. DAHLGREN

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**SECTION I**  
**MANAGEMENT THEORY**

# THE MANAGEMENT PROCESS

DR. HAROLD KOONTZ

MEAD JOHNSON PROFESSOR OF MANAGEMENT,  
GRADUATE SCHOOL OF BUSINESS  
ADMINISTRATION,  
UNIVERSITY OF CALIFORNIA AT LOS ANGELES

I am delighted at being able to make my first appearance at Fort Belvoir, and at the Army Management School. Of course, I have always been interested in management; in fact, I was formerly a government manager, having fought World War II at a desk in Washington before going into industry, which I never expected to leave. However, I received a doctor's degree during the 1930's, when I could make more money by going to college than working. As a result, I was eventually offered a professorship at UCLA.

I then found out that the only real way to be able to continue to do research in the field of management was to pose as a management consultant. In this way, one could get inside industry and study its problems.

I do believe that, whether we are talking about business, government, charitable organizations, or, indeed, our universities, our efficiency in mobilizing our human and material resources depends on the development of an environment conducive to good performance. Indeed, I think our fulfillment of our social responsibilities depends more on the quality and vigor of those who are in charge of managing than on any other single factor. We

must look at the basic task of the manager as creating and maintaining an environment conducive to the best possible performance on the part of individuals.

By and large, I am admittedly a universalist in the field of management. By that, I mean that I think that the fundamentals of management apply regardless of the type of enterprise — business, government, or any other. In this regard, one of my colleagues said to me one day, "If what you say is true — that is, that managing is managing — how do you explain this? According to the American Institute of Management, the three best-managed enterprises in the world are Standard Oil, the Catholic Church, and the Communist Party."

At first, I was taken back a little; but then I got to thinking. Give the president of Standard Oil a chance to learn something about Communism, and he would probably make a pretty good chief of the Communist Party of Russia. Give the Pope an opportunity to learn about the oil business, and he would probably make a pretty good head of Standard Oil. And give the Chairman of the Communist Party a chance to learn Latin, and he would probably make a pretty good pope.

This somewhat frivolous thinking does underline some things that cannot be overlooked. In the first place, no one that I have ever seen or even expect to see is a one hundred percent manager. One manager with whom I worked, who ran a multi-billion dollar business, might have been as much as sixty to seventy percent manager, because he spent a substantial part of his time doing public relations work and various other tasks that are essentially non-managerial.

In the second place, as we look at management, we have to realize that, since people must manage something, we therefore need to know something about the areas in which we are managing. In the third place, as long as people are people, they expect to see in their superiors a certain degree of expertise in the field in which they are managing.

Thus, as I see management, there is more to the job of managing than just managing per se. Moreover, as I see it, besides being a basic science, a basic field of knowledge, if you will, management is also an art. I have heard a lot of useless discussions about whether management is a science or an art. It is like asking whether engineering is a science or an art, or whether medicine is a science or an art. Whether we are talking about medicine, engineering, law, or even baseball, they are all arts; by that I mean, in being arts, they entail the application of basic knowledge to a real life situation, with a view toward improving actual performance. It is this basic knowledge aspect which I am convinced is universal.

I used to think of the basic managerial task as one of getting things done through people. We



**DR. HAROLD KOONTZ**

Dr. Koontz received his A.B. from Oberlin College, his M.B.A. from Northwestern University, and his Ph.D. from Yale. He has been an instructor at both Duke and the University of Toledo, and assistant professor at Colgate. After serving in an executive capacity with the War Production Board, the Association of American Railroads, and Trans World Airlines, Dr. Koontz joined UCLA's Graduate School of Business Administration in 1950.

Dr. Koontz presently serves as consultant on management and management development to various companies throughout the U. S. and in many foreign countries.

Outstanding among Dr. Koontz's published works is his *Principles of Management*, which he co-authored with Cyril O'Donnell and which has become a modern classic in its field.

(This article was adapted from Dr. Koontz's presentation before the Army Installation Management Course at USAMS on 15 Sep. 1969.)



still hear it said that way, and it is not entirely wrong. However, I have always felt somewhat uncomfortable with this concept of managing, because it seemed to imply a kind of psychiatric manipulation of those who report to us. As far as I am concerned, there is nothing worse than an amateur psychiatrist in the form of a manager who attempts to manipulate his people. There is really nothing more futile.

As I have perhaps already made clear, I see the job of the manager as one of creating, of designing, an environment much in the same way as the engineers design little black boxes. The manager's job is one of designing and maintaining an environment for the effective and efficient performance of individuals working together in groups.

This, of course, infers a lot of things. First of all, it infers that an environment must be created which entails the selection of objectives or goals with due consideration being given to relative strengths and limitations and the total environment in which a firm operates.

I have gotten a little tired of hearing that business executives must be taught social responsibilities. As though anybody lacking a sense of social responsibility could long operate a business any more than the military could long operate their installations without being aware of and responsive not only to the economic and technical environment but also the social, political, and ethical environment.

It seems to me that the business of business is business, even though the business of the Army may be defense, the business of a commercial enterprise may be trade, and so on. Thus, while there are different objectives to contend with, these objectives must be selected in the light of the external environ-

ment. I believe that this is done much more than most people realize.

Now, in order to be meaningful, the specific objectives and goals must be verifiable. One of the great developments in business management during the last decade has been an upsurge of interest in the selection of verifiable goals stated either in qualitative or quantitative terms so that it can be demonstrated that they have or have not been accomplished.

It has been common in industry to say that the goal is to earn a fair profit while producing a quality product and being good citizens in the community. This is a fine objective, except that it has one deficiency, which is that it really does not mean very much. The reason is that there is really no way to find out for sure whether such an objective is being accomplished or not.

One of the areas where at least some of our government agencies have lagged, I think, is in the establishment of verifiable goals and objectives. Some officials in government agencies have told me that they believe that business has a greater advantage over government in that business has a profit goal or objective. But what, really, is profit? Profit is nothing more than the surplus of whatever your purposes are over the inputs of cost. I had this brought home to me rather dramatically a few years ago when I was asked to look in on a space science company. This company had been having a lot of financial trouble. I found that this company was run by space scientists with space scientists for space scientists. Only reluctantly did they agree that the comptroller need not have a Ph.D. in physics. After I had sat down with the top management

group of this company, I was surprised to find that they regarded profit as a dirty word. They had proved it, too, beyond a shadow of a doubt.

After I had spent some time with the top group discussing their objectives, where they should go, and how they should go about it, they agreed with me that they should operate their company in such a way as to bring in by sales the most dollars with the expenditure of the fewest possible dollars. This is what profit really amounts to.

It seems to me that, as managers, officials in the Army or Defense establishment, or in any agency of the government, we should have a surplus objective, that is, to get the most return, in terms of whatever our objectives are, at the very least in terms of expenditures. That is all that profit really is. But, notice that this does require verifiable goals and objectives. In this regard, one of the things that is most interesting to me about program budgeting and the whole concept of cost effectiveness is that, if it does work, it does tend to force a definition of goals and objectives.

Granted, goal-setting is difficult. However, creating a favorable environment to ensure good performance requires a commonly understood goal. It must be understood, it must be meaningful, it must be verifiable. After all, people must work toward something. For a favorable environment, there must also be an intentional structure of roles. This is so, because there has always been a tendency for people to look at an organization chart and think that is indeed an organization. But if people are to function effectively, they must fill certain roles. Roles do not really exist unless they include specific, verifiable goals, an understanding of the duties for which individuals are

held responsible, and an understanding of the horizontal, vertical, and diagonal information relationships that surround a role.

Certainly, a great deal more is entailed in an organization than just making up an organization chart. It has been customary during the past decade, in fact, ever since William Whyte's *The Organization Man* came out, to downgrade formal organization. I have been fighting an uphill battle with my behaviorally-oriented colleagues in academic circles on this very point. I have been told that what is needed in business or government is not formal organization but teamwork operation. But what kind of team is meant? In every decent athletic team I have observed, the players are given roles for which they are trained, play patterns, with somebody calling the signals from the sidelines. It is a very structured situation.

I have had some of my colleagues tell me that modern managers should be like the conductor of a symphony orchestra who leads his subordinates in bringing forth music. But a moment of reflection will reveal that a symphony orchestra represents one of our society's most highly structured and authoritarian situations. The individual musicians play given instruments in which they have been specially trained. Scores are written with parts for each instrument, and each individual player follows the exact interpretations of the orchestra conductor. I have never heard of a symphony orchestra conductor who permitted his clarinet sections to improvise as suited their fancy. I am not suggesting that you run your section or branch like a conductor runs a symphony orchestra. But it does give me some qualms to realize that, while a symphony orchestra represents one of the high-

est forms of human cooperation, it also represents one of our most authoritative and highly structured systems.

Another element indispensable to a favorable environment can be summed up this way: every manager, no matter what his level, should regard it as a basic part of his job to remove any obstructions to performance on the part of the people for whom he is responsible. I realize that this element may be somewhat cloudy, but just reflect for a moment: How many of your own superiors have done the best they possibly could to remove obstacles to your performance? I myself can think of only two. But I remember them with the greatest degree of respect, for they made it possible for me to perform in such a way that I was able to move ahead in the companies with whom I was associated.

Of course, I recognize that sometimes the obstacle to good performance can be beyond a superior's control. In this case, our first obligation, it seems to me, is to press upward in the organization structure with a solution to remove the obstruction.

A few years ago, I had an argument with a colonel at the Pentagon in regard to some accounting matters in defense contracting. It had something to do with overhead rates and seemed a quite nonsensical thing to me. Finally, the colonel did agree with me that what was being done was not right. But when I asked him why something could not be done about it, he said, "You don't realize how big the Pentagon is." At that point, I was more or less forced to give up.

On the other hand, I have had some enlightening experiences with the railroad industry, which is probably the industry that is most heavily shackled by the regulations

of labor unions in this country. I have noticed, however, that during the past ten years, through patient research and a fairly unemotional appeal to the public, some of these shackles have been removed.

Another element that makes for a favorable environment is a condition wherein people are doing their jobs because they want to, because they enjoy doing them. They have found that it is worth their while to do their jobs in a certain way and for certain goals. In this connection, how many companies are there that induce people to do things in certain ways without actually telling them they have to do things in certain ways? In our best managed enterprises there are many.

Of course, there are also situations in which we have to get people to perform in a certain way, not because they want to or find it to their advantage to, but simply because they must. There is no question but that in many positions and roles, creativity or imagination is not called for. I think sometimes we tend to forget this. I can't imagine, for example, that a bank would want a highly imaginative or creative teller. And, when I was with the airline industry, I can remember it being said that we did not want imaginative, creative, or experimental pilots. We wanted our pilots flying according to the book.

Clarity must exist in order to have a favorable environment. The more I see of management problems, the more I am impressed that a great many of them are due to the fact that someone does not understand missions, goals, positions, authority delegations, procedures, policies. As a matter of fact, I recommend to the business executives with whom I work that they operate on the principle that, if there

is any possible way for a human being to misunderstand something, you can be sure that he will.

Unfortunately, in both business and government — and perhaps even more so in government — we tend to try to be clear by spelling out things in much too much detail. When we spell out a position or procedure in too much detail, what we are sometimes really doing, without meaning to, is putting a person in a straitjacket. Of course, it is much more difficult to be clear and not excessively detailed than it is to be excessively detailed.

I have always used as an example of a clearly-expressed statement without excessive detail the orders given to General Eisenhower when he was put in command of the Allied forces during World War II. His orders read something like this: "Proceed to Europe. Establish headquarters. Take command of the Allied forces and win the war against the Germans."

It is interesting to note that the earliest meaningful writing on management came from practitioners; the academics were yet to be heard from. We have had such examples as a French industrialist, an English executive, a General Motors vice president, a British management consultant, a German militarist, and others — all of them practitioners. This situation existed almost without exception until World War II, after which the academics jumped into the field of management. Today, "management," "administration," and "organization" are virtually interchangeable terms.

Looking around at the universities, including my own, we find economists, sociologists, psychologists, social psychologists, mathematicians, sociometricians, econometricians, engineers, and even

occasionally a few management specialists. Today, it appears, they are all in the field of management. Looking at this great expression of interest, especially since the year 1950, one can see that the intrusion of academics into the field seems to have resulted in a welter of differences of opinion. This can easily be borne out by reading the management literature.

It has been difficult to understand just why the veritable flood of management literature has revealed such great differences of opinion and so much confusion and just plain inaccuracies. It bothered me as to why a group of such supposedly intelligent people could reach such widely different conclusions about management. It did not bother me so much as a professor, but I did begin to wonder about the number of discerning and intelligent practitioners with whom I worked. They appeared to be so much confused as to the right things to do in management.

As a result, I did make an attempt to analyze why all these differences had come to the fore. I found that approaches to the study of management fell into a number of different schools. This may be familiar to some, because I addressed myself to this subject in an article on what I call the "Management Theory Jungle." Among these schools, it seems to me there is one that, for lack of a better term, I would call the empirical school of management, which is exemplified primarily by the case approach. This might be called the study of experience and was, of course, initiated by Harvard University many years ago in its attempt to bring respectability to business education.

It is generally conceded that Harvard borrowed its case ideas

from the law. The law, at least before the Supreme Court changed it during the last 35 years or so, used to be based on precedents. But in business management, people's jobs are not based on precedents. What happened a week ago, a year ago, or five years ago, will almost certainly not happen again. Therefore, I refer to the case approach as the study of unstructured and meaningless historical experience.

Before I give the impression that I am being unduly harsh on Harvard, I do admit that, as a clinical or pseudo-clinical device, the case study is an excellent thing. I would also point out that Harvard has gone through quite a revolution in the past few years; thus, today a Harvard professor is expected to give some of his own opinions on various things and discuss his own analyses. It is being recognized that the advantage of using experience is the ability to distill from experience to find out fundamentally why something is occurring.

A second school may be referred to as the human behavior school or approach. Here we confront mainly the psychologist, who has so deluged the field of management with his writing in the last few years. The psychologist reasons this way: The task of the manager is to get things done through people; therefore, we should study people and interpersonal relationships.

I do not deny the importance of being able to understand people, of being able to understand what motivates people — and, by the way, we don't appear to know much more about this than we did 30 years ago. All I am saying is that a study of people is not enough to enable us to really understand management.

A third school of thought may be referred to as the social system

approach, that is, looking at management as a social system. It is primarily sociologically oriented. I submit that understanding cultural relationships and group relationships is vitally important to management. I happen to think that such an understanding is more important than a psychological understanding.

In our society, many of the problems of the group are tied in with the cultural group background. I believe, for example, that our so-called racial problem is not really a racial problem per se. It is essentially a problem of cultural misunderstanding.

A fourth school advocates the decision-making theory approach. Here are included those people who believe the whole subject of management should be approached from the viewpoint of decision-making. The reasoning is that, since the task of managers is to make decisions, the manager should study decision theory. It is true that decision-making is the core of planning, and planning is the basis of management. I myself have been a little reluctant to accept the decision-making approach as the total approach to management. It seems to me that, all things considered, the actual making of a decision in one's operation is not likely to be the toughest part of the job. If we know the goals we are shooting at and make a thorough analysis of the best way to get there in the light of the total environment, the decision may be easy. Therefore, I would criticize this approach as looking at management through a keyhole.

One of the leading decision theorists once said to me, however, that I had misunderstood them. He pointed out that they do not emphasize the decision alone but, rather, they treat of everything

preceding a decision and everything that follows it. I felt like telling him that, since he had not left out anything, I did not think he had defined anything.

Closely related is a fifth approach, which has been gaining in popularity, that compares the management job to a communication center. According to this approach, the manager's job is to receive information, process it, and disperse it. This fits in very well with computer technology. I think it is an interesting approach but it does not quite satisfy me. As one authority has put it, all the manager is, is a telephone switchboard, doing no more than receiving information, processing it, and disseminating it.

A sixth approach is one that I would call the mathematical approach to management. It seems that, in recent years, we have been trying to apply mathematics to everything. In fact, one colleague of mine maintains that, if it can't be expressed mathematically, it is not worth expressing. I do not happen to agree with that; to the contrary, I agree with the eminent sociologist who maintains that a fact is not nobler because it is numerical, nor reasoning necessarily more logical because it is mathematical.

There is no question in my mind that the application of system approaches and mathematical devices to management problems represents one of the greatest potential breakthroughs in the whole field of management. But there is still mostly talk with very little action, and for a lot of reasons. For one thing, there has been too much emphasis on pure mathematics and not enough emphasis on the techniques of application. For another thing, there has been too much mysticism and mumbo-jumbo. I am afraid that

among my mathematical friends there are those who love to play with mathematical models, without really stopping to consider whether they are useful or not. I call this the "Narcissus" complex — falling in love with one's own mathematical models. But, while mathematics is important, it is no more management than astronomy is mathematics.

The seventh approach might be referred to as the operational school of management. In organizing knowledge, we in this school are trying to develop an operational science. We have borrowed the term "operational" from a logics professor who has defined an operational science as an organized body of knowledge related to the practice or art which it is expected to serve.

Our departure is to answer the questions, What is knowledge? and, How can it best be organized so as to fit into the practical operating manager's job? We proceed from the standpoint of certain pigeon holes — the functions of managers, namely, those labeled planning, directing, organizing, staffing, and controlling. Then there are subsets of classifications.

We have to remember that no knowledge is really useful unless it is organized. A series of data does not in itself make for knowledge. Unless there is a framework by which we organize knowledge, what we have is structureless data.

Providing a framework is essentially what we are trying to do in developing operational science. I don't mind calling it a science, because, after all, science is merely organized knowledge. I would have to admit that organized management knowledge is still in a pretty crude state. There are several reasons for this. First, we did not start a serious attempt to organize

our management knowledge for the most part until after World War II. Second, I doubt there is a more complex task in all of our society than managing, taking into consideration all the variables entailed. In fact, the greatest mathematicians of our time have run out of mathematics in attempting to put the manager's job and all its variables into some kind of mathematical formula.

But, as we look at the crudities of management science, we should not have too great a sense of inferiority as compared to the so-called exact sciences. I can recall being terribly impressed with accounting many years ago. Then one day I happened to be visiting a friend who owned a medium-sized company. They were getting ready to close the books, when the accountant came in and asked, "Would you rather show a \$400,000 profit or \$400,000 loss for last year? I can do it either way."

When I got into the aviation field, at first I was likewise terribly impressed by the engineers, who could always call for the analyses of various scientists, had many formulas and complex computations. I observed them, for example, spending many man-hours designing an airplane wing. After all this work, the prototype was later taken out and stressed with weights and chains to see where it would break. It appeared to me that they weren't so scientific after all.

We should keep in mind that principles are not inflexible laws. One management authority points out, in fact, that there are really no valid principles of management. He uses the example of the principle of unity of command and claims that it is invalid, in that there are so many cases where people report in some way to more than one superior. The principle of unity of

command really says that the more an individual reports to a single individual, the less it is likely that there will be confusion and the more it is likely that there will be a greater sense of loyalty and responsibility. It does not say that people should never report to a single superior.

We have to approach the job of managing as a means of organizing knowledge. As I have indicated, I would approach it through looking at its processes. I think of it as classifying the managerial functions of planning, organizing, staffing, directing, and controlling.

Some persons have disagreed with much of what I have said. They maintain, for example, that, while I define controlling as measuring and correcting, corrections take place through re-planning, re-directing, re-staffing, or re-organizing. This is true. It simply indicates that managerial functions indicate an interconnected system. I cannot imagine a company, for example, as really having a quality control system if all it did was to have an inspector at the end of the assembly line throwing out all the rejects. You might get quality control out of this but no production.

It seems to me that correcting understandably entails some re-planning, some re-organizing; it sometimes entails re-staffing and sometimes changes in our whole directing technique. We cannot separate managerial functions in practice as distinctly as we can in literature.

But we have to have some way of organizing our knowledge; otherwise, our knowledge becomes a blur. From this operational approach, I would say that what we really have in the way of management knowledge is a hard core of basic management theory and science. I must include also what can be called

distilled experience. Certainly, an understanding of human interrelationships and an understanding of group behavioral relationships can be useful.

Anytime we try to put our bits of knowledge into pigeon holes, we necessarily must leave something out. On the other hand, there is a problem in that, as long as we continue to look at the whole universe of knowledge without limiting what we should be looking at, we will never learn anything that could really be useful.

I have not given enough emphasis to leadership. What is it? Leadership is essentially followership. Every manager should be a leader, but how do we get people to follow? Individuals will follow if thereby they see a means of satisfying their own personal de-

sires and wishes. It seems to me that, in the management situation, the manager will create such an environment that his people will want to follow him.

What I have tried to do in the foregoing is sum up some of the basic approaches to management. I realize that the act of managing is a very important social responsibility. I realize that managing is a very difficult and complex job, and, as I tell my students, those who aspire to the management field must have a very high frustration tolerance because people are the most frustrating things in the world. As I look at it, at how complex, difficult, and frustrating it is, I am glad that I am a management consultant rather than a front-line management practitioner.



# MANAGEMENT AND ADMINISTRATION

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I was quite pleased to think about the opportunity to be a keynote speaker. This is a privilege I have not had often. As you realize, this provides an opportunity for great latitude and scope. Colonel McLean and Colonel Hancock gave me almost a blank check to set the tone for three weeks. I could destroy the whole works here, I guess.

As an ex-serviceman and a dean, under some pressure on a university campus these days, I proceeded to sit down and make a list of things about the Army and about the services in general which I felt might need some appropriate changes. I thought perhaps the stimulus induced here might influence you to go back and look a minute. So, in the process, I came up with several items which I felt might be appropriate to work into this keynote address. Having listed them, I retired to my office at the university one evening and proceeded to write a very fine manuscript, suitable for publication, of the proceedings of this particular session. About the time I got finished, 15 students came in and took over the office. Unfortunately, when they burned the office the manuscript was lost. And I was compelled not to talk about your problems or mine. (I hope you all know I'm kidding.)

One of the things I would like to do in this session is to encourage

a little bit of participation. While the campus life is rather interesting and I have many problems, I would like to hopefully start some discussion and elicit from you some comments or questions pertaining to this whole field of management and the management process. In doing this, I thought that perhaps I would try to key in on four major topical areas. Certainly this is going to relate to all of you in the sense that you are involved in the management process — whether or not it be in the nursing situation or in the installation of a major military facility. There is quite a trend in the field of administration. I'm going to use these terms synonymously — management and administration. Schools of administration are blooming out, largely, as a result, combined with what used to be known as business administration. Into this we find all sorts of interesting courses and curricula being developed — hospital administration, medical administration, legal administration.

This is a very interesting situation, because the concept here is that, regardless of where you look in an organization, at the top (chief executive, primary officers) there is a real common element, whether it be a nonprofit or profit institution, whether it be a school, hospital, etc. Those of you who might have some profit type of experience in

your background are familiar with the old story of the person taking a plant tour with the manager. This person asked, "How many people do you have working for you?" The manager said, "One out of ten."

I want to begin this discussion of the management process by seeing if we can't come up with a definition of that term. It, of course, means administration if I can be arbitrary.

Secondly, I'd like to identify some of these common things that I have just mentioned — the elements, if you will, of the management process common to all of us, regardless of whether we are in a profit or a non-profit situation.

Relating to these five essential elements, I'd then like to spend a little bit of time with the tools and techniques — things I'm sure that over the next three weeks you will be discussing in various details. Some of you are now being faced with some of these. We can per-

haps discuss some of them, and this may bring up some questions.

Finally, I'd like to bring up a problem that I think is a problem for me; it probably is a problem for those of you in Army installations, particularly in dealing with civilian personnel, with specialists, in bringing in or perhaps even, in a sense, retaining some of the young, bright people that form our input today. I'd like to bring up the question of democracy in the management process. We have a good deal of this in the educational setting — students demanding to run the university, faculty demanding to do likewise. The focus in the president's office is rather interesting. The dean's office is being exposed to some of this. Everybody, in essence, wants to participate in the decision-making process.

I'd like to explore this and see what's happening in some of your situations and get some dialogue started with regard to this, because



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(This article was adapted from Dr. Kane's presentation before the Army Installation Management Course at USAMS on 17 Mar. 1969.)

it's an area whose urgency, I'm convinced, isn't going to go away. I warn you at the beginning that I'm a bit of a conservative in this respect. My faculty tend to refer to this as being a little bit autocratic. I like to think of it more in terms of common sense or being conservative. Nonetheless, regardless of where you folks stand in all of this, I hope that we can get into an interesting discussion.

These are the principal areas, and I will begin simply by talking about management and see where this leads us.

I propose the more common definition of management, and that is the process of getting something done through people. Those of you who have been exposed before to management texts and management courses know that there are a significant number of definitions of the management or administration process. But this is the one that offers more focus on accomplishment, less focus on high morale, all of the attributes of individual development, etc., the focus being primarily related to getting something done. These definitions, I've noted, change over time. Very simply, in earlier days when we were talking about management by objectives, the definition tended to be quite simple. Essentially, one of the most common ones is that management and the management process is a sense of direction. This still has a lot of merit today.

Sir Eric Ashby, a Britisher who has been very active in the relationship of science and technology, has said, in essence, that management is a process — an art — of using other men's minds. He has written some very interesting things which certainly (in the Army setting; and with my own case of managing highly specialized, professional people) contain interest-

ing concepts. He sees the administrator as some type of machine, similar to a computer. The job of all of us machines is to integrate information and to transform all of this information into simple decisions — the information coming from two directions. In one instance this is a flow of information from society at large. And then, of course, in Ashby's relationship to the scientific community, the rather elite group, there is another flow from science. This combination is the administrator. At this juncture, then, we are supposed to put all of this together and come up with some rather straightforward, simple solutions. Those of you who have dealt with some rather interesting problems related to highly specialized people (who think in terms of loyalty to the discipline rather than to the individual, institution, or organization) will find that this is a very interesting situation.

We talk about recruiting as a very difficult process, not only in most professional ranks, but certainly in hiring for economics, business. There is a great deal of what we call pirating going on among our known universities. At one of our meetings, one of the deans was talking with great disgust. He said we offer more money; we offer fringe benefits; we reduce teaching loads from 12 to 6 hours; we enhance research opportunities; each professor has 12 or so research assistants; teaching is becoming less and less an important type of thing; and what do we have? All of this heavy turnover among these very able but not too loyal groups. And in frustration, he said, "Business schools today are simply becoming hotels for transients." The point that he was making is a very real one. All of us who manage these types of people find the frus-

tration of very talented people, highly respected, but their loyalty would be to their discipline, and not to any particular institution or organization. It does create some problems and it does create some turnover.

Ashby's definition, then, I think you will see coming along more and more often. He has a very interesting point which is related to this — a bad administrator may fail in any one of three ways. First, because he cannot elicit the appropriate reply from experts; that is, those of us who are managing these types of people have to somehow know how to program this technologist so that when we put the right input into this fellow, we get the right answer. We don't have to know too much about science or this specialty; but we have to be able to ask him the right question to get the right feedback. Some of these fellows are so busy creating problems that we are kept busy trying to solve them. These are the fellows that give you 25-page memos when you have asked for a short, succinct statement. Secondly, because having secured the information, we cannot create a very simple, synthesized decision or a clear-cut persuasive decision. In other words, we have such problems here in our own mechanism of communication that we just can't simply integrate this. Finally, because these decisions do not relate to the body politic, to the art of politics, they aren't focused on reality.

I don't like to dwell on this, because we are going to come back to it. But I have a very interesting situation. I don't know whether you people get into this justification business or that you use much paper. But I'm sure you are blessed with all kinds of time so that when somebody comes in and files some-

thing with you, you have plenty of time to sit down and read all of this to put it in proper budgetary perspective and send it forward. But, the other day I saw one of my bright professors who, by the way, is always ten minutes late for class for some reason. I complained about it once on his standard of performance, and his response was that he does more in 40 minutes than the other fellow does in 50 minutes. But I asked for a simple justification for a piece of equipment for our statistic lab and I got 35 pages from this professor. He had taken about all of the time and used up two weeks of my time and was late with the deadline. I got this something like 8 hours before I had to go to the president. The president had been screaming because he had lead time from the legislature. I had to condense the 35 pages down to about a paragraph and a half to get it into the budget, justify it, and get it into the president's office. I stayed up all night digesting this whole thing. Got it into the budget; it was approved; came back, and we didn't have some of the support — namely, research assistants — to help operate the equipment which assisted the lab. He complained bitterly to me that I did not have a feeling for supporting research, and that these things automatically go together.

These are some of the things that we are facing and which I will touch on in just a minute. This is why I think Ashby's definition is interesting — the art of using other men's minds. I think this will change, but it will be a definition that you might want to put in your notes and come back and look at as our system of management changes over time.

Despite the variations with respect to this definition, the key to

any modern definition, as far as I am concerned, is accomplishment — getting things done, having a set of objectives and reaching those objectives. In this sense, every administrator or manager is a strategist. The real key is to come up with a strategy, setting objectives — a plan, if you will, for action — and then in the process to implement strategy and measure your results.

The emphasis here is on the performance aspect and the chief executive is responsible for some basis of performance, some charter. From business firms we would expect economic performance — not employee happiness, not psychological well-being — but economic performance. A very current trend that I am concerned about is the urban-ghetto problem in turning to business firms which are franchised for a certain purpose and using these firms to solve some of the more broad problems. There are some very sincere and positive pressures on management today on the part of firms that are getting involved without relating this to some payoff. In other words, the balance sheet. There is some very good room for business firms to get into this kind of problem, particularly when it is to their self-interest. We somehow miss this economic performance aspect.

If we look at a hospital or an institution, we would say that this has a charter of performance related to some type of health care. If we took a military installation, we would relate this somehow to a defense posture or structure. But in many of the organizations there is a very sincere effort to avoid the major charter or pass it up simply by losing it somewhere.

Are there any librarians in this group? Well, I will comment on my problem with the library. I al-

ways thought that a centralized library somehow had a charter of performance related to a librarian, who is an administrator and manager, who supports personnel, but who nevertheless runs his own shop. How would you define the charter of that type of operation? How would you measure its performance? I would think primarily in terms of student usage, faculty usage. When is the librarian the happiest? When all the books are on the shelf. They are all neat; they are all indexed; they are clean; there are no stains from students or faculty; no wear or tear; the edges are not turned down; etc., etc. Her charter, then, and what she tries to do in our particular case, is to maximize a non-usage kind of charter. We certainly have had some rather interesting discussions. This is a simple example of what can happen if organizations should drift from the principal charter or the principal mission.

I believe there are some business firms, some hospitals, some libraries that somehow miss the full impact of their charter performance. So I would like to emphasize that management is a process of getting something done through people. The manager then has the resources — primarily the manpower resources — to bring this into being.

Very quickly, I would like to go on to the second point, and perhaps the best way to do this is to chart some of this and maybe give you, very rapidly, what I call the five essential elements in the management process.

First of all, if we start with performance and say that what we are after is performance and that this is the charter, this is the justification, this is the true meaning of a firm or organization — then I'd say to you as a manager that there

are primarily five activities that you will be involved with. The first one is to take the charter and reduce it to some basis of an organization — an organization plan. The organizational analysis is simply a process of allocating responsibilities, establishing positions, based on functions, and to bring all of this into focus. In other words, taking the organization, its people and resources, and organizing it into some kind of structure in which you put down the various responsibilities of each component and how they will interact.

The second one is the process of the input of management talent — recruiting and selecting. Here we are responsible as managers to provide an input of new talent. Those of you who have gone up the ladder as specialists find yourselves feeling very grim about this whole problem of losing your specialty in moving over into management proper. I used to be a professor of economics and marketing. I deteriorated to the point that I probably wouldn't allow myself back in the classroom. Dean Hayes, who appears here once in a while, likes to tell the story about the engineer who is constantly carrying his slide rule around. He hasn't done any engineering in 15 years, but it's like keeping your foot in the door. Deans like to think they are still able to teach; in case a storm hits they can always go back in the classroom. Engineers can go back to the drafting room or wherever engineers come from.

Are there any engineers in this group? I will tell the story about this one engineer who was going across the campus. He's rushing along — typical engineer — with his slide rule. He thinks very much this is the numbers era. If you can't quantify, you quantify anyway. He comes past the chapel and sees on the marquee that Reverend

So-and-So is going to speak on the subject, Is There a God? He missed the preliminary and saw only the question. He brought out his slide rule and came up with the answer yes. There is always a yes or no answer.

The third responsibility of management is the job of appraisal, evaluation. We have an organization structure. We bring in people to man the various positions, we give them the job, and then we have to appraise their efforts. Not only do we have to do this as managers, but we also have to be very much attuned to management development. It's not enough just to meet your objectives, to turn in a good balance sheet, to stay within the budget — you are also responsible for bringing people along, for helping them to develop, pointing out the strengths and the weaknesses and somehow focusing all of this into an educational training or evaluation program. Here we get into the very difficult job of counselling, of holding conferences with these people on how they can improve, indicating their strengths. This whole area is aimed at individual development.

The fifth is one which most of you don't have to worry too much about. That is compensation. The development of rewards, bringing together all of the reward structure, the compensation structure, which is related to good performance.

So I have said that, number one, the major element here is the organization planning operation. This is the part of the job of the manager concerned with the structuring of assignment, setting forth objectives related to certain functions that have to be performed — telling the people what their responsibilities are; what their authority is; and defining how they relate to people at the same level upward or

downward. You might think that all of this function here may very well be related to a start-up situation. What do you do in this process? We are all engaged in this, aren't we? It's reorganizing. That's one of the most useful strategy elements that management has — to reorganize.

What are the various reasons for reorganizing? You can't accomplish your objectives, and it's pretty tough to move. What do you come up with? One of the best strategies we have when we are constantly evaluating our structure as well as our people. I think this probably needs very little comment at this juncture. This is a recruiting and selection point. This is the input. In my particular shop this is an extremely important element, because we are in a very dramatic growth process at the University of South Carolina, and the recruiting job is tremendous. The kind of input that we bring in is going to make us or break us. It's an interesting challenge. These will be my mistakes five years from now when some other dean inherits this. They are always the ones that you inherit; they are never the ones that you recruit yourself.

The third process — the appraisal, evaluation — is the step where you measure the strengths or the weaknesses or the process of establishing par. How good are you if you don't have par? If someone doesn't set something up for you — a goal or objective to aim at — you don't really know.

In management development, we talk about training, coaching, counselling.

These are the things that we must do. How do we go about doing them? If you've got to change a faucet, you can talk about the processes you go through to exchange or fix the faucet, but somebody has

to hand you the screwdriver or pliers. So now I would like to relate the tools.

Stemming from this process here is the department plan, the goals, the objectives. Also related to this is the organization charter. Also, the job or the position description. Essentially, what we are saying here is that the department plan says something about interpreting the performance. The organization charter is simply a visualization of our organization. The job description is your charter, your authority, your delegation of responsibilities down through the organization, to get the implementation within your group. This is the means of assigning to the positions its appropriate share of risks.

Now, out of this we have standards of performance, which are simply interpretations and statements of what you expect to accomplish, a further elaboration of the job description. The job description or position is primarily based upon what you expect the job to do. Standards, then, are interpretations of this. What a useful device. What would we use it for? You all have job descriptions, I'm sure. I know where they are. They are up there on the shelf. Fifteen years ago I remember filing it up there. All have an organization chart. When was the last time you looked at it? When you were trying to find out who that character was at the committee meeting who disagreed with you.

These are very viable, useful tools. The only problem is that we somehow never get them out and use them. But look what they do for us.

First of all, some place here you've got to have a yardstick to relate performance in the appraisal system to actual par — what you

expect. Standards of performance are your interpretation to your employees as to what you expect. It's the relationship statement between the two of you. When you then agree that this is par and he takes his first shot from the tee all the way down, you then have some basis for coming back and saying he did a lousy job or he did a good job. Also, these are very useful for hiring people. How do you know that we want Mr. Sullivan here? He's got all kinds of experience; he's been through this particular three-week course. What are you looking for? If you don't describe what you are looking for, then how do you know when it presents itself to you? The gals do this very nicely. When they are looking for mates, what do they do? They know exactly what they want and then they start the screening process. The men are constantly in a sweep-search situation.

But this is the input or the tool which, along with the job description, allows you to evaluate what it is you are looking for. The worst people I have to deal with on my college campus are the recruiters. They come in and whom do they look for? The top one. They've got to have the top 10 of the class. They never relate this to what the guy's going to do. The Chambers of Commerce in the United States could take great lessons from these recruiters. Because they come in with no job specs, they don't know whether they want this fellow or that fellow. In the process, it's a very costly operation for them, and it usually takes our students about 2 years before they finally figure it out. Now, the wise firms are sending recent graduates back to the campus for fraternity brothers or sorority sisters and the word is getting through. Don't go near X, Y, or Z corporation, be-

cause all they are doing is stockpiling — great recruiters, but it's a whole new situation when you get there. They put you through a three-year training program, and after you get through with that — boom! — down to the bottom of the ladder and start climbing. Use this. Make sure you know what you are after. This is the tool.

Then the appraisal proposition. How can you tell somebody how well he's doing when you haven't attempted to measure his strengths and weaknesses? When you get through with this, you are essentially telling him what further education he needs — in other words, the whole process of coaching, counselling, and, hopefully, developing the individual. You are interested in this person's individual development, he knows that you are interested, and you are attempting to help and are in communication with him, not just once a year because the specs tell you that once a year you will sit down and write an appraisal of some type, but periodically, and preferably separately from this last step. Changes, based upon rewards, compensation.

One firm I know is doing a terrific job of this — but I bet you are not doing much of it within your own system because it's very difficult. But if you've got a very fine person in your Army unit or your particular installation, what do you try to do with him? Who gets transferred out? Is this proper? It's true of secretaries in the College of Business at the University of South Carolina. I will maintain, however, that that is a short-run viewpoint. Eventually, that person leaves anyway. He leaves with the feeling that you kind of held him back.



But in corporations, I've found (and I think this may be true of basketball coaches) that the fellow who has developed a reputation for promoting people, for bringing them along, has very little trouble back here with the input gain. One of the key retention elements, according to a GE study of employees, was the impact the first boss had. Such impact was one of the most important variables in retention. I had the privilege of sitting in a corporation where they had what was called a war room. This was a fairly large room on all sides of which were beautiful visual aids. They had the entire organization planned by name all the way down through their management level. These were coded and so forth. When the president came in, he sat down at the little table. And all the division chiefs were there. And the president went around, "Why hasn't this fellow been over to such and such school? He's been sitting in that job three years. Why isn't he out?" That VP sat there trying to cover. All of a sudden now they are all bragging about the manager's reward system. Now they are taking pride in this particular company. I brought Joe along; he came out of finance. Or, he came out of marketing into that general management job. Or, he came out of my division to end up over there. In the long run, the word gets back that if you want to really move along in this company, do everything you can to get in Joe's division.

Do you have any questions?

(Question: May I ask you a question with respect to your appraisal and evaluation of your professors? From my experience with most college professors, I've never seen any visible signs in the classroom of evaluation of performance as related to the subject matter

that is put out. Is it being done in actuality?)

*Dean Kane:* Let me tell you what we do. We say three things to the professor. Your promotion or your advancement is based on three things — teaching; research and writing; and your contribution to committee meetings. We completely ignore two of them and go on one. This has been responsible for a tremendous outpouring into the journals around the country of a lot of garbage, particularly with a quantitative voice. Have you read any quantitative articles lately? By the time you get through all of this formula, the guy has said something pretty simple.

I think this is changing. Do you know who is making the change? The students. Bless them — almost 98.8% of them. They are saying, "Look, we are the forgotten people," so now in our particular college, for example, the students are running a professor's evaluation system. I get the feedback. In schools such as mine, I would say it is just as important as research. At others, particularly the more prestigious, the pressure to publish or perish — if you will — is very real. It is a tremendous problem. Why? Because they learn. The professor knows where the key is. He knows or he learns very rapidly. They say all of this in their standards of performance, but really what they are talking about is, how many are going to be published this year?

This is a point where you as managers can use this particular tool to your advantage. Because what you are trying to do is to delegate to three or four people certain responsibilities, the sum total of which should equal your job. In other words, if A, B, and C do their job, it adds up to the fact that you've done yours. How many of

you are faced with the situation of Charlie coming into the office, saying, "I have a very serious problem. Do you know when we were talking about X, Y & Z? I have looked into that situation and, Mr. Hare, I don't know really how to handle this." What does Mr. Hare do? "That's OK, Jim; I will take care of that for you. Just leave it with me." Tom comes in and says, "I've been trying to reach this goal and I've got a tough situation with imbalance and what have you, Charlie." Charlie says, "Look, I'll take care of it." And pretty soon you look at Charlie's desk. He will be working night and day, and his wife never sees him. What have they done? That's called delegation upward. They will do it for you every time, because they are not assuming responsibility for par. I once knew a corporate president who had this problem. Do you know what he did? He took the desk out of the office. He had one chair, a very little coffee table, a telephone stand. When these bright guys came in and looked for a place to set that thing down on, there was nothing there.

(Question: I'd like to get your comments on the impact of centralization on these five elements. Out of the five here, as I see it, four are operating under the centralized concept.)

Dean Kane: The whole question which we are running into is centralized management versus decentralized management. Quite frankly, I just don't draw the distinction. I don't know any other management system except decentralized. It's just a matter of degree, unless you are doing everything yourself, or unless you don't have any organization chart at all. If you are talking about an organization, the mere process of establishing that is a process of decentralization. What

are you doing? You are saying to your job description or your position description that this position will be responsible for such and such and then you list them. And then for employees involved you even go so far as to write standards of performance. So what have you done? You've decentralized your operation. I don't know if I've answered your question or not, but if you are saying centralized versus decentralized, the centralized system is you, period. Regardless, if you have a centralized or decentralized system, all of these things are relevant. You have to break out functions and structure and organize people and provide responsibilities.

(Question: Your definition of getting things done seems to be the short view also. It seems to be inconsistent with what you are saying here. You have talked about compensation, about development. Therefore, I think it is essential that in your definition you have more than just getting things done.)

Dean Kane: What I was stressing is the standards of performance. The basis for your appraisal and evaluation is what? Charlie's a good man. He doesn't have a mustache or wear a beard. If these are important to you and if you are evaluating and eventually compensating Charlie for that and promoting Charlie for that, fine. If, on the other hand, you want him to accomplish certain performance factors, then these have to be in here, too. Everything that is related to your definition of performance and related back here to the position and to your charter. Now, my point is yes, you are much better off in achieving performance if you have "a happy family"; if they are working together; if you are free of strife, of politics, etc. If everybody

is happy in pursuing his own development, professionally and individually, this is a good climate. But if you have got all of these things, you don't have an organization, you have a country club. You might as well realize what you are trying to maximize (and this is getting a little into this participative management area). The very last thing a business firm does before it goes broke is to put out another manual of rules and regulations.

(*Question:* In your definition, when you say you are measuring me or my organization by how we perform, aren't you saying that if we do a real good job, make lots of money, then it's good management? But on the other hand, this may last only a short time. If we

go through all the management processes that you point out, I may not make as much money, but my organization may last a much longer time.)

*Dean Kane:* There is no problem. All you have done is shift measurement devices. You are thinking of long range instead of short range.

(*Question:* But I changed your definition. Good management isn't necessarily a measurement of how much is accomplished.)

*Dean Kane:* Let me be a little facetious. Let's say everybody is a marksman, shooting at a 100% performance rating. My point is that, if you don't say something about performance, you are absolutely right. But that is where I place the emphasis.

**SECTION II**  
**COMMAND**  
**MANAGEMENT**

# MANAGING THE ARMY TEST AND EVALUATION COMMAND

MAJOR GENERAL FRANK M. IZENOUR,  
COMMANDING GENERAL,  
U. S. ARMY TEST  
AND EVALUATION COMMAND

In this article, I propose to discuss some aspects of the operation of the U. S. Army Test and Evaluation Command, the headquarters of which is located at Aberdeen Proving Ground, Md. I am certain that most people are aware that the U. S. Army Test and Evaluation Command is one of nine major subordinate commands of the U. S. Army Materiel Command. Of the other eight, seven are commodity-oriented in the development and production of specific types of hardware. The ninth command, the Safeguard Logistics Command, does just what the name implies — it provides logistic support for the Safeguard Command.

I want to dwell mostly on the management of testing within TECOM, but first let me briefly outline our mission and organization.

## Mission and Organization

Our most important mission is the performance of suitability tests and the subsequent evaluation of those tests. At present, we are conducting engineering tests, which determine if the item is correctly designed and produced according to all specifications and requirements. These are tests of measurement and are performed by skilled engineers, scientists, and technicians, both military and civilian. We conduct service tests, which pair the new

or modified item with the soldier and the environment. These tests tell us if the item, the man, and the environment in which he operates are compatible. They are conducted under conditions as close as possible to those likely to be encountered on any of a dozen prospective battlefields. We also perform the check tests. These are service-type retests of equipment modifications required to remedy deficiencies found in the original service test and which precluded type classification. Finally, we conduct initial production tests on the first items of a production run. These tests verify the adequacy and quality of materiel when fabricated by production line methods. You might term these four various tests as "things which we do for ourselves," since we develop the plan of test, conduct the test, and evaluate the results.

Upon the completion of the engineering and service tests, we forward a position letter along with our test reports to the Army Materiel Command, the Combat Developments Command, and the Department of the Army staff.

Reports are written as tests progress. They are written, reviewed, and boarded, as required, at each of our test agencies. They are forwarded by the agencies to TECOM headquarters, and there they are carefully reviewed by test

engineers, experienced combat officers, and directors in the appropriate materiel test directorate.

Following this review, each report on which TECOM is required to take a position is brought before a headquarters review board. This board is chaired by the Deputy Commanding General and is composed of the Deputy Chief of Staff, technical advisors, and the Director of the Plans and Operations Directorate. This group submits its recommendations to me for one last review and my final decision.

Through these review and evaluation procedures, TECOM develops an unbiased, straightforward position which considers not only the literal interpretation of the Qualitative Materiel Requirement, the technical characteristics, and other specifications, but also the real world as far as comparative performance and use are concerned.

The TECOM position letter is backed by test reports and is the total fruit of our efforts expended

toward only one objective, that of ensuring that the soldier in the field has the best functional piece of equipment that is feasible within the realm of development capability.

Next are those "things that we do for others." These are normally termed customer tests. Many of the developers of Army materiel require various types of tests to be conducted during the actual research and development state, as well as the production phase, of a program. They do not always have the facilities, manpower, or technical experience to conduct the types of tests required. By direction of the Army Materiel Command, we conduct these tests for the developer, whether it be a military in-house operation or an item being developed by a civilian contractor. This general category of test includes, but is not limited to, such tests as military potential, engineer design, product improvement, research and development, and surveillance. In the conduct of



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His military career began in 1931. Since then, he has completed assignments as instructor at the Command and General Staff College, as a member of the staff and faculty of the Army Infantry School, and as a member of various staffs of the Department of the Army. He has also served with the 2d Infantry Division (Korea), the 4th Armored Division (Europe), and HQ European Command (Bonn).

(This article was adapted from Gen. Izenour's presentation before the Operations Research Systems Analysis Executive Course at USAMS on 14 Nov. 1969.)

these tests, all we do is the actual testing. The customer develops the test plan and distributes the test reports.

The third part of our mission is a routine matter as far as the Army is concerned. We direct and control the 15 installations and activities that are assigned to us for the performance of our mission.

Our fourth mission could be the subject of an entire article in itself. However, since it is not especially germane to this discussion, I will just say that it has to do with the management and operation of a national missile range at White Sands, New Mexico.

Finally, our mission entails what might be termed what we do to remain professionally competent. As more modern, more complex, and more efficient implements of war are developed, we must stay abreast with these advances in the field of testing. Our Plans and Operations Directorate has two divisions which devote their entire time to the study of instrumentation and methodology.

Since we can no longer follow the practice of our forefathers in testing a rifle by firing at an oaken block at a hundred paces, we stay up to date by the use of the most modern and complete instrumentation available. However, as each new missile or artillery projectile is prepared for use, our instrumentation requirements change and we must be prepared to make those changes as soon as possible. Millions of dollars are spent each year by TECOM to buy, rent, improve, and maintain testing instrumentation. This instrumentation runs the gamut from a simple ruler to a sensitive device used to measure changes in pressure, to the most complex radar or tracking network. Our studies in instrumentation are not limited to ascertaining what

new equipment is needed, but also investigate what new uses may be made of existing equipment. Considering the cost of some of these instruments, it just doesn't make good sense to use them for only a single operation.

There is a continual flow of information from the Instrumentation Division through the whole directorate, and the Methodology Division makes use of much of that information. This division is concerned with the improvement of practices and procedures in the testing of Army materiel and the establishment of new practices and procedures for future testing. Just as the Army is constantly developing more complex and sophisticated weaponry and equipment, so must it continually review the test methods of yesteryear and replace those which have become outmoded.

#### TECOM — A Brief Description

Now let me give a brief description of my command. First, the headquarters is a directorate-type organization. It has a materiel test directorate for each of eight different areas of hardware. These areas are Infantry, Armor, Field Artillery, Air Defense, Aviation, Electronics, Nuclear/Biological/Chemical, and General Equipment. For items which may require added attention due to complexity or special handling, a systems test manager's office is established. An example of this is the systems test manager's office for the MBT-70. Rounding out the test managers' portion of the headquarters is the Plans and Operations Directorate, which functions as a G-3 or Operations section. I am assisted by a Deputy Commanding General, a Special Assistant, Chief of Staff, and a Deputy Chief of Staff whose primary function is in the area of test management.

Along with the other supporting staff offices, I have a Logistics Directorate, a Personnel and Training Directorate, and a Management Science and Data Systems Office. Because of our peculiar mission of functioning as the Army's major testing organization, these latter directorates and offices actually become very involved in many of the technicalities of the testing itself.

Our testing facilities consist of a network of 15 installations and activities spread across the United States and in Alaska and the Panama Canal Zone. We have five proving grounds: Aberdeen Proving Ground, which is not only the headquarters of TECOM, but is also the oldest installation of its type in the Army; Jefferson Proving Ground, Indiana, which specializes in the proof-testing of all types of munitions and explosives other than missiles; Dugway Proving Ground, Utah, an installation which is part of the Desert Test Center and where most items in the nuclear, biological, and chemical categories are tested; Yuma Proving Ground, Arizona, which not only participates in many of our suitability tests but also serves as our desert environmental test agency; and the Army Electronic Proving Ground, at Fort Huachuca, Arizona. At White Sands Missile Range, New Mexico, we test all Army rockets and missiles and also operate our nation's only entirely overland national missile range.

Missiles and rockets from the Air Force and the Navy have most of their first launchings here, as do many of the various stages of numerous NASA projects. At Ft. Lee, Virginia, we have a General Equipment Test Activity, where both suitability and customer tests are conducted on items that are in use throughout the Army regardless of branch. This includes most items

of individual equipment as well as many Transportation and Quartermaster Corps items. At six different posts in the United States, we have service test boards. These are collocated with the center and school of a particular branch and the Combat Developments Command agency for that branch. Thus, the Infantry Test Board is at Ft. Benning; the Aviation Test Board, at Ft. Rucker; and so on. The U.S. Army Airborne, Electronics, and Special Warfare Board is located at Ft. Bragg. It is primarily involved in testing airborne and radio equipment. Rounding out our test facilities are the Tropic Test Center in the Canal Zone and the Arctic Test Center at Ft. Greely, Alaska. These, of course, are our environmental test centers for the tropics and the Arctic, respectively.

So much for the present organization and facilities of TECOM. It may be of interest to know that it was not always this way. When the command was first activated in August 1962, it was composed of the testing activities and installations of all of the technical services as well as the CONARC boards. TECOM inherited not only the physical properties of many more than 15 test facilities, but also the managerial techniques, philosophies, and languages, none of which was especially compatible with any of the others. Through the combined processes of elimination, consolidation, modification, and evolution, we have finally reached the place where we all speak the same tongue, and, what is equally important, we have passed this on to our customers. We are operating with the minimum number of activities and installations required to accomplish our testing mission.

A few facts and figures about the size of the command about which I have been talking might be of



interest. Aside from the land used by our subordinates, which are tenants, our own installations have available in excess of 4,000,000 acres (4,121,054 actual) that are either owned, leased, or co-leased. TECOM has improved the land and installed equipment to the tune of \$815,418,872 at the various installations, and in equipment alone at the activities has invested \$12,612,653. For the fiscal year of 1969, our total planned operating costs were \$248.4 million. Our actual costs were \$241.4 million.

For the present fiscal year, our planned costs are \$251.5 million. Our payrolls run to \$116.6 million for our civilian employees and \$37.7 million for our military. Our authorized strength, by the way, is 5,751 military and 10,594 civilian. Actually, we operate slightly below these numbers, due to the military manpower drain and limitations on the hire of civilians. As with any organization, military or civilian, we are of the opinion that we always can use just a bit more money and a few more people.

Now let me turn to what can be called the heart of this discussion — our test management.

#### Test Management

While it may be determined in any one of a half dozen ways that a new item is required, once that determination is made, almost all development follows a fairly well established pattern. A qualitative materiel requirement document is issued. This document is the combined work of the Combat Developments Command, the Office of the Chief of Research and Development, the Army Materiel Command, and one or more of AMC's major commodity commands. Test personnel have been in on the ground floor and established the number of test prototypes that will be required,

and where and when they will be needed to aid in the preparation of a coordinated test program. This program must also fit into the master TECOM test schedule in order to make the maximum use of TECOM manpower, facilities, and test personnel. The appropriate materiel test directorate at TECOM notifies the installation or activity which will conduct the various tests and this installation or activity prepares the plan of test. The plan of test is then forwarded to TECOM headquarters and, in the case of the service test, also to the Combat Developments Command, which approves the plan.

I have already mentioned the difficulty TECOM first encountered in bringing cohesiveness to a new organization composed of many elements and using just as many languages. This situation was multiplied several times over in the Army Materiel Command.

Even as of this date, AMC has upwards of 250 commands, laboratories, depots, and other activities. You can easily understand what an enormous task it is to manage such an organization even when everyone is following the same plan and speaking the same language. It therefore became incumbent upon TECOM to simplify, modify, and coordinate its own activities; but to do it, this operation had to be done in such a way that it would, upon completion, be compatible with the AMC plan. Since 1964, the Department of the Army has pursued the development of an Army-wide system for materiel management. AMC has been the prime proponent and developer of such a system, and right now is operating under the AMC five-year ADP plan, which foresees the achievement of uniformity in the systems by which it accomplishes

its mission during the time frame of fiscal years 1971-1975.

The TECOM input to the AMC five-year ADP plan is known as the Test, Evaluation, Analysis, and Management Uniformity Plan (TEAM-UP). Simply stated, TEAM-UP is our program to standardize our automatic data processing equipment and to effect data output compatibility with all other AMC major commands, within the context of the AMC five-year plan.

In broad terms, TEAM-UP is comprised of three phases. The first phase includes the installation management, scientific, and engineering applications for Aberdeen Proving Ground, Deseret Test Center, Jefferson Proving Ground, and Yuma Proving Ground; scientific and engineering applications for the Air Defense Board at Ft. Bliss; and installation management requirements for the White Sands Missile Range. Installation management includes all those areas which might be termed as supporting the testing function, such as payrolls, cost analysis, manpower, and other administrative functions.

The second phase covers scientific and engineering requirements for White Sands Missile Range. Typical functional areas here include data reduction and scientific analysis.

The third phase will include the installation management, scientific and engineering types of applications similar to those in the first phase for the other nine TECOM activities.

The conceptual purpose of TEAM-UP is two-fold. We want to provide essential control and management tools necessary in planning and directing the TECOM mission. We also want to provide the necessary capacity and flexibility to accomplish the required functions not

presently feasible on existing automatic data processing equipment. When TEAM-UP is operational to its full extent, it will offer numerous advantages, four of which are: (1) it will modernize the command control system through the use of modern, compatible ADP systems and hardware and make the system more responsive; (2) it will provide the capability and capacity to accommodate an increasing complexity and volume of scientific and engineering workloads; (3) it will make TECOM installation management system compatible with the systems of AMC; and (4) it will satisfy all current TECOM ADP requirements and still provide the capability for expansion and mobilization needs.

It would be nice to say that we started out with a successful program to implement TEAM-UP, but, as with many operations, we had to go about this by the old trial-and-error method. In order for us to direct operations, we had to devise a system by which meaningful information could be collected, collated, and reduced to both understandable and useful data. We had originally developed a test scheduling and management system (TSMS) which was designed to provide information to the headquarters on the existing commandwide situation. This information was to cover such areas as scheduling, funds, workload, personnel, test types, and conditions at the test sites. Theoretically, it was to provide commandwide information of the total status of testing. However, the system was geared to provide management by exception, and although total information pictures were being developed, an effort was made to highlight the completion or the failure to complete critical event testing. It was soon

realized that this system was unwieldy and lacking in full responsiveness to the needs of the command.

One of the major deficiencies of the system was that insufficient interface existed between various categories of information, such as between the system itself and cost accounting. This shortcoming brought about a study by our management science and data systems people and resulted in a modified system known as TRMS. TRMS is the management information system for TECOM's mission area. It covers test schedules and the resources, both in manpower and money, required to accomplish our mission.

TRMS is divided into two basic segments — a five-year command schedule of predicted test work and the active segment which covers current testing. This active portion carries an original schedule for test milestones plus any revisions to these milestones including the reason which dictated the change. The actual occurrence of milestones is also indicated.

Estimated man-hours and costs are projected for each test broken out by monthly values. The actual man-hours and cost consumption for each test is reported monthly into TRMS. Also shown is the total estimated man-hours and cost required for a test, along with the cumulative consumption to date.

TRMS, of course, follows the TEAM-UP concept of using existing data in other master files in order to prevent duplicate reporting and duplication of master files. For example, all man-hours and cost data are extracted from the cost accounting master file in a form which satisfies both TRMS and our Personnel and Training Directorate's need for utilization data.

The system is designed so that our workload can be machine-summarized in a multitude of ways. As an example, time-phased workload summaries are available by TECOM test agency, by developer, by commodities, by types of items, model numbers, and test priorities. Many other combinations are possible and can be obtained as required. These many combinations of workload analysis which are possible through TRMS make it a valuable means of pin-pointing current and potential workload problems and of improving the assignment and scheduling of test work.

This is TECOM's system for projecting workload, both long- and short-range, for authorizing and scheduling test work. For determining manpower utilization, for determining test status, and for identifying potential operational problem areas, TECOM is now initiating a project which will extend the application of TRMS to our subordinate commands so that, rather than simply furnishing input to headquarters, they will use a more detailed form of TRMS in their day-to-day management.

In addition to being more responsive to the information retrieval requirement, TRMS allows for the gathering of information that previous systems could not supply. An example of the improved situation is the actual number of additional reports which TRMS provides. The previous system, TSMS, provided 18 reports which were usually insufficiently developed and reduced. Consequently, these reports were not the management tools that they were intended to be. TRMS is set up to provide 38 documents. These reports dovetail and are expected to provide the information which was not hitherto available. At first glance, it might seem that the production of an additional 20 reports

would impose an additional burden on the recipients of those reports. Actually, the distribution of the reports under TRMS is much more selective, and where under TSMS it was necessary to peruse all 18 reports to obtain specific data, now the same facts can be obtained from three or four reports. The study of all output of the system is no longer necessary in order to obtain information pertinent to only one test operation. Accuracy and timeliness are the most important characteristics of TRMS. When it is fully programmed for TEAM-UP, even greater reliability is expected.

#### Concluding Remarks

As a result of a recent in-house study, I have requested the approval of HQ AMC to make some organizational changes in my headquarters. The details of these would be of little interest here, but the concept behind them will show one way in which I am incorporating modern scientific and management techniques into our operations.

My current plans and operations directorate has several functions which, in an organization like ours, are somewhat incompatible. These are the day-to-day operational control of the test mission and the mid- and long-range planning, as well as searching for better test technology. Under the proposed change, the first two day-to-day operations and our mid- and long-range plans will be located in a directorate called Test Operations. A separate directorate will be responsible for methodology and instrumentation and will have added an operations research function. I have named

this latter organization the Test Systems Analysis Directorate. The designation of the Test Operations Directorate explains its mission. The Test Systems Analysis Directorate will be the element to which I look to apply the state of the art to test requirements or extend the state of the art to better methods of testing and to identify instrumentation systems to accommodate these new test methods. The operations research and systems analysis specialists will be trained to adapt OR and SA techniques to new and old test methods as well as to management and to logistics functions. The studies of the Operations Research Division will form a base upon which the Test Operations Directorate can produce its mid- and long-range plans.

Sitting where I am, I am interested in only one thing in the long run. I want to see the Test and Evaluation Command fulfill its mission of determining the suitability of Army materiel in the most efficient, effective, and responsive way possible. I want TECOM to do this by using whatever programs or systems or techniques can help us achieve our mission. I know that any system or technique which results in a better job of testing and evaluating will be instrumental in the final mission accomplishment, which is furnishing our soldiers in the field with the type of equipment and weapons which are necessary for them to do their job.

I hope the foregoing constitutes a capsule description of what we do — what we do it with, and where — how we manage the operation — and what we look for in the future.

# MANAGEMENT IN THE ARMY MATERIEL COMMAND

BRIGADIER GENERAL JAMES G. KALERGIS  
COMPTROLLER/DIRECTOR OF PROGRAMS  
HQ. U. S. ARMY MATERIEL COMMAND

**T**he basis for this article was my appearance as a guest speaker at the U. S. Army Management School. I would like to mention that it is always a pleasure to be invited to speak before a group in an academic setting, since it provides me an opportunity to escape from the day-to-day pressures of business in discussing in depth the whys and wherefores of the Army Materiel Command (AMC). Further, the cloistered atmosphere of a seminar is conducive to a frank discussion of the problems of management and how the management processes are applied. At AMC, like all organizations, we have problems that have not been fully resolved; but as we identify the problem, we work towards solutions.

To establish a background for discussing AMC, it may be useful to retrace the past, recall how AMC came into being, what AMC is, and why adjustments in the organization and management techniques were and continue to be necessary in order for AMC to do its job. As you will recall, in 1962 the Army was reorganized along essentially functional lines with the Combat Developments Command responsible for determining how the Army will be organized, equipped, and fight, AMC responsible for providing what the Army will fight with, and USCONARC responsible for training individuals and units and

preparing them for their combat mission.

This was a sweeping change, particularly from the standpoint of providing "what the Army will fight with," since prior to the reorganization the materiel functions were performed by seven technical services and many logistical functions were accomplished by the Army General Staff.

So from the tribes of seven technical services, all having different cultures, languages, and customs, AMC was activated in August 1962. Obviously, there were problems, both large and small, in getting this giant off the drawing board and fully operational. Also bear in mind that, in addition to the normal mission of providing "what the Army will fight with," AMC, like the remainder of the Army, had to react — and quickly — to the requirements generated by the Cuban crisis in the fall of 1962. Needless to say, the Cuban crisis exposed some wholesale logistical problems that might not have been immediately detected if the Army had not been required to position a sizeable combat and combat support force in the southeastern part of the country so that, from this exercise, AMC could identify specific areas that required immediate correction.

Also, about the time that these problems were being solved, the build-up in Vietnam started; and as you might suspect, this surfaced

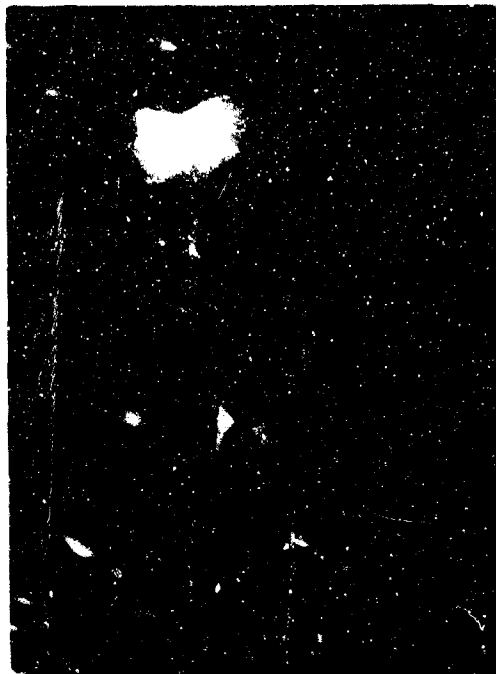
additional problems or insufficiencies that demanded special consideration. So from activation to the present, as problems have been surfaced, changes in the organization and methods of managing have been necessary.

Certainly the problems of amalgamating the seven technical services into one command, coupled with the increased demands caused by Cuba and Vietnam, were not as easily solved as I may make it sound; but in spite of the pains of conversion from seven to one, increased requirements to support a active war, and all of the other normal day-to-day activities, AMC has successfully accomplished its mission in superior style. This is past. The management problems AMC faced yesterday are not the same management problems AMC faces today. And tomorrow's problems may be different from both of these. As a consequence, AMC must consider the future and be struc-

tured to meet the needs of the future.

Before getting on with the specifics of management within AMC, it is necessary to consider the size of AMC. AMC has a combined land acreage equal to the size of the state of Maryland, with the population of Corpus Christi, Texas, an annual budget equaling about \$14 billion dollars, and an inventory valued at roughly \$21 billion. Of our annual budget, approximately 75% of it goes to industry, and at AMC we recognize that we are "married" with industry, since this is the backbone of our production capability. This is big business; and AMC, the third largest corporation in the U. S., behind General Motors and the Air Force, must be one of the most diversified business firms in the world.

So, with this size operation, and with this size financial responsibility to the taxpayer, management, at all echelons, is a vital part of AMC's business.



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Before assuming his present position in June 1969, Gen. Kalergis served in Vietnam, first as commander of the I Field Force (Artillery), then as its Chief of Staff.

(This article was adapted from Gen. Kalergis's presentation before the Army Installation Management Course at USAMS on 14 Oct. 1969.)

With this thumbnail sketch of AMC's origin and size of operation, let's look at what General Chesarek has termed "the beginning of a second generation AMC."

When General Chesarek announced his plan for a change in the managerial responsibilities of AMC Headquarters, he specified that these changes were not a major revamp of the command structure but that, with a leveling off of the support required for Vietnam, AMC could enter a consolidation period and start addressing procedures and controls towards better cost effective operation. As a means to accomplish improved management, better control over missions and functions, and to reduce the span of control of the CG, responsibilities in the headquarters have been realigned. First, General Chesarek has established three deputy commanding generals and a civilian deputy. The principal deputy under the current realignment not only serves as the CG's alter ego but also is the resource manager responsible for people, money, and facilities within the command. The Deputy for Laboratories, which is not a new billet, will continue to focus on the scientific community and direct the technical operations of AMC in-house laboratories. Also of interest to the Deputy for Labs is enhancing the commodity command's laboratory capability.

For improved management of the functionally oriented staff, two new deputy commanding general positions have been established. The first, the Deputy CG for Materiel Acquisition, is concerned with the functions of research, development, engineering, the industrial base, procurement and production, and determining materiel requirements.

Logistics support, that is, supporting the Army in the field,

brings together the distribution, transportation, and maintenance functions. Also, this Deputy CG is responsible for accomplishing AMC's international logistics mission and the coordination and control of the vast AMC depot complex.

Other realignments have been and will continue to be made to improve the management capability of AMC and this concept of organization structure and control involves a readjustment of centralized control to give a better degree of operational flexibility. Top officials are in a position to develop management strategies appropriate to their level of authority. With the improved visibility that will be provided by computer applications and new managerial techniques, top managers will be in a better position to influence their operations. This concept will provide the CG more time for overall management and enable him to continuously make an appraisal of his organization and seek methods for better performance.

As General Chesarek stated in a recent interview, the realignment of responsibilities within the headquarters has shown great promise and gives him more time to think.

A new AMC staff element in AMC is the Plans and Analysis Coordinating Office. The AMC Planning Board at Aberdeen is being moved to HQ AMC and will provide the nucleus of a central AMC planning activity that has long been lacking. This element will address two areas of management: 1. The creation of overall plans specifying roles and objectives, and 2. Coordination of the use of systems analysis techniques in all facets of the decision-making process. In the planning area, this office will look at DOD and DA plans and the long-range materiel plans of CDC.

Against these measurements of workloads and objectives as well as concepts which might have an impact upon future AMC operations (such as the use of the C5A and wholesale distribution and redistribution of assets), AMC can develop plans for future operations. In the systems analysis area this office will set policies and procedures on the use of systems analysis techniques throughout the AMC structure. Techniques addressing materiel systems problems, as well as alternatives and related trade-offs in a decision-making process, will be developed. Concurrently, the systems analysis capability will provide the Commanding General with an in-house capability to address problems whose solutions can be attained by use of systems analysis techniques.

In all organizations, two important questions which must be addressed are, at what echelon should decisions be made? and, what does the decision-maker need to make a valid judgment? Certainly there are no established formulas for establishing a decision system, but what is clearly recognized is that at each echelon certain basic data must be available for the decision-maker to evaluate in the decision process. In AMC we will rely heavily on an improved management information system to assist in the decision process. To strengthen this portion of AMC, the Director of Management Information Systems has been elevated to a position of responsibility equal to that of the functional managers. A point of emphasis -- this is not an automated data processing office.

When data processing systems were first introduced in the Army, they were employed in individual functional areas, principally to reduce clerical labor. As a consequence, responsibility for systems

design remained the sole concern of the functional manager, and ADP was simply performed as a service for him. With the evolution of computer capability and the increase in applications for which computers were used, it became apparent that systems designed along functional lines did not express the interrelationships that exist among functions in an organization. As a consequence, ADP systems frequently produced incompatible results. For instance, financial obligations processed days after procurement actions are taken do not reflect the true situation at the time they are run. Worse yet, management information extracted from these functional systems is incompatible and misleading.

The need to integrate our functional systems has resulted in the upward movement of the ADP chief in our organizations. He is perhaps the only person who can tell when the requirements of the functional manager's systems impinge on the interrelationships of the integrated system. The integration and standardization of our ADP systems are having another effect which will be felt when NAPALM (National ADP Plan for AMC Logistic Management) is installed.

The realignments I have just discussed are only part of the AMC second generation story. Next, and particularly significant, is the new look being taken into merging the functions of Materiel Requirements and Procurement and Production into a single Directorate of Requirements and Procurement. This merger is based on a concept of integrated life cycle management as shown below:

- a. Orient management activities to systems and items.
- b. Integrate related systems



and items into management categories.

c. Integrate management of the most critical life cycle functions.

d. Eliminate overlaps and duplication.

e. Improve visibility of staff materiel managers.

f. Integrate project managers' actions with appropriate materiel category.

g. Relate materiel management to Army missions.

The mission of the Directorate of Requirements and Procurement will be to direct all materiel management activities pertaining to PEMA program and budget, requirements, procurement and production, contracting, readiness, and related Army stock fund program. Within this directorate, there will be 16 commodity divisions which will represent various homogenous groupings of materiel into categories.

These divisions were developed after a thorough analysis. This included consideration of the number of major items managed, the number of secondary items in the system broken out by category, the PEMA Army Acquisition Objective, the value of the maintenance program by category, the number of contracts and dollar value by category and other similar considerations.

AMC, as I stated earlier, is a flexible organization that must be tailored to meet immediate and future management needs. These realignments are designed to improve AMC's ability to manage this huge complex with the vital mission of providing "what the Army will fight with." General Chesarek has accepted a challenge to manage better with less, and AMC is oriented toward finding, through better management, means to accom-

plish our mission with reduced resources.

There are other less significant changes in organization which I won't discuss which will improve our ability to do a better job with fewer resources and improve our responsiveness to our customers. Of course, all of the improvements are directed towards mission accomplishment; and to steal from a phrase from a giant of industry, the National Cash Register Company: "AMC can't afford to have one dissatisfied customer."

Next, and all important, is a discussion of the AMC philosophy of management; and, of course, management means who makes the decision, who can say yes, and who can say no. One method of describing the decision-making process is to consider it as a set of gear wheels. In the center as the idler gear — no offense meant — is top level management, and within this entire gear are the three principal drive gears — functional, commodity, and project management. As you will see later, the outer ring represents some of the techniques used to control the gears and keep the inner gears in balance. The idler gear, or top level management in this example, sees that all other gears are turning in the proper direction, and acts as a guide to keep the gears meshed.

The most widely discussed management technique at the moment in AMC, of course, is project management. This intensified management technique has been discussed in detail at all levels of government, and there have been strong advocates of the system as well as those who have been equally vocal in their criticism of this technique. While AMC originally pioneered in this area, General Chesarek views this as a special form of management to treat things of special im-

portance, either dollarwise or operationwise. If too many items are project-managed, it loses its special status and becomes routine. Essentially what had happened in AMC was that, due to the impetus of Vietnam and the urgencies that were created by a combat theater, AMC had projects which were under this special form of management which could have been discontinued and placed under functional management. For a start, in the beginning of the "second generation" the number of project-managed items was reduced from 67 to 46 and the responsibility for all of these except 8 decentralized to the commodity commanders. Bear in mind that project management is not being deemphasized in AMC, as it is an important management tool, but we will be a bit more selective about when it is used. It is a special management tool and will be used to manage special items or systems.

As I remarked earlier, AMC recognizes the benefits of project management and, of course, will continue to use it as required by DOD and DA for those items where intensified management is required. What AMC will have will be few project managers, but on the real key programs.

Next, we manage by commodity. Eight of the nine major subordinate commands of AMC are organized according to commodity groupings. Also in the realignment of responsibilities in AMC, the role of the major subordinate commander has been strengthened, since the majority of the project managed items have been assigned to the respective commodity command. As a result, the CG AMC now has only to look in one direction to determine how effectively a particular commodity or commodity group is being managed.

The last form of management we use is the functional or area boundary method which is more of the classical form of management. In AMC, functional management conforms directly to the organization structure at the headquarters. Simply stated, the head of each major organizational element is the program director for those functions for which he has staff responsibility. Under this method, the Director of Research, Development and Engineering is the program director for RDT&E; the Director of Materiel Requirements, the program director of PEMA; and so on. Under functional management, influence is exercised by programing and budget actions.

The outer gear, the one that keeps the other gears together, represents some of the management techniques and procedures used by AMC to keep the gears from stripping.

Without discussing each technique, I will highlight an important segment in the overall scheme, that is, contract definition in the life cycle of materiel. Contract definition is the formal process during which preliminary design and engineering are verified or accomplished and firm contract and management planning are performed. It is a checkpoint which precedes full-scale development and allows for a determination whether the conditional decision to proceed with engineering development should be ratified. Contract definition is also performed for establishing firm and realistic performance specifications, precisely defining interface and responsibilities, identifying high-risk areas, and establishing schedules and cost estimates for planning purposes for the total project.

Another technique widely used in AMC is the command objectives program. Command objectives are

statements of major goals that have been approved by the CG as elements of the AMC Five-Year Program and provide management direction and guidance. The CG uses the rate of progress of the command objectives as prime indicators as to how well AMC is meeting its mission responsibilities.

Quarterly, the CG is given a progress report on the progress made toward meeting these prescribed objectives. Although AMC does not require its subordinate commands to use this management tool, we strongly urge them to consider command objectives as a measurement means, since at HQ, AMC this program has proven its worth in determining how we are accomplishing our mission.

In this climate of increased attention to improved management and better utilization of those resources available, we are giving maximum attention to the life-cycle management techniques. The use of a life-cycle management model as a management technique provides for periodic decision/challenge points requiring a decision to proceed to each succeeding phase of the materiel life cycle. The AMC Life-Cycle Management Model implementing the DA model has been completed. This "road map" for managers to follow during the phases of materiel systems master planning is currently being implemented. An important element of the AMC model is the interface of each process that is an AMC responsibility with that part of the process accomplished by CDC and CONARC. This systems management approach is a way of life and will have a significant bearing on surfacing problems and providing the visibility needed to make a valid decision.

As a corollary to improved management are the requirements for

better techniques in the application of resources. In this area, the Army in general must improve so that only the resources needed to accomplish the desired results are used. Specifically, AMC as the Army's "big spender" must continuously develop techniques that preclude the application of resources to marginal, low-yield projects. AMC is, in fact, working towards this end and devoting considerable effort in this field.

One project to assist AMC management is "WARCAT," which is the acronym of a Workload and Resources Correlation Analysis Technique. The object of this project is to determine what workload indicator will best express the command job and enable AMC to forecast and predict workloads. We are also trying to determine the means to correlate the workload with the dollars and manpower to give us the ability to predict where our dollars and people should be.

The study is currently being conducted internally within HQ, AMC but will eventually be extended to field organizations to review their efforts within the command structure. The task is to investigate the probability of indicators and means of correlation which can then be followed in detail to prove their value, the end product being a system by which the command can predict its needs, provide justification for the budget; and if a reduction in dollars or people is inevitable, furnish guidelines for determining where the reductions should take place.

Next, and directly related to "WARCAT," a project entitled the AMC 70-90 Study is being conducted. The object of this exercise is to positively identify those AMC activities, functions, and installations which could be eliminated, consolidated, or otherwise be re-

duced. A blue ribbon committee has been established to direct this study and to tie this effort into a DA long-range stationing and installation plan. While this study covers a 20-year time span, the results will provide positive direction for the immediate critical years of FY 72 and FY 73. The point of the matter is that AMC must look beyond the current time frame and develop appropriate plans to meet the requirements of the future.

The technique that has received and will continue to receive high priority in AMC is cost analysis/cost estimating. In today's environment, the newer and more sophisticated materiel programs require significantly greater resources than did their predecessors or those items which they will replace. For these reasons, deliberate cost control and validation measures have been designed to assist in the decision process. We are fully aware of the criticism leveled at the Army for cost overruns and the need to minimize such overruns. Accordingly, the credibility of our justification to DA and DOD must be raised by improved cost estimates that reflect the most likely expected cost. Through the extended use of detailed cost tracks of prior and current cost estimates, maximum cost limitations are established. Naturally, early detection of cost trends and the reporting of such trends to management are vital so that appropriate recommendations or decisions may be made.

As I indicated earlier, AMC has many management problems and when we identify them, we take the remedial action needed to correct them. Frankly, this requires a little time and, naturally, it requires overcoming some built-in objections because people at all echelons are prone to be a little parochial and to resist change.

Since many of our management requirements are based on trends in DA and DOD, perhaps a brief look at some of these would show the direction we are heading. One trend that bears consideration is the increased emphasis DOD is placing on decentralization of authority. This was clearly indicated by Dr. Foster (DDR&E) when he spoke before the Armed Forces Management Association recently and stated that once programs are approved by the Secretary of Defense, OSD actions will be limited to monitoring and the service will be responsible for conducting the program.

According to Dr. Foster, a "tilt" system is being developed that will flash an alarm to all those responsible when a program begins to deviate from a steady course. That is, if the projected schedule slips beyond certain limits or the project price exceeds a threshold, or performance falls short for a given stage, DOD will get an automatic "tilt" signal. Further, an in-depth review at OSD level will be accomplished for each major system before it is approved for production.

If there are no "tilts" and if the milestone is reached, the program manager will review the program and be able to reach a decision to proceed, stop, or redirect his effort. If all systems are "go," the money will be made available and the manager will go to the next milestone.

The planning, programing, and budgeting system at DOD is also under revision and a revised procedure is currently being staffed by DOD. This revision, if approved, will work essentially like this: Early in the calendar year, the Secretary of Defense will issue tentative fiscal guidance to the services and the Joint Staff. This guidance will define total fiscal constraints for the next five-year period. Following evaluation by the JCS and

Military Secretaries of the impact of this tentative fiscal guidance document on Joint and Service plans, OSD will issue a Fiscal Guidance Memorandum to each service for each program year. Sometime during the spring, using the Fiscal Guidance Memorandum as a basis, the services will submit to the Secretary of Defense their Program Objective Memoranda (POM's). These will express total program requirements within the constraints of the Fiscal Guidance Memo. POM's will be evaluated from the economic analysis standpoint. Following review of the POM's, the program decision documents will be issued by OSD. The budget will then be prepared in the current manner.

From our analysis of this procedure, it appears that Program Change Requests (PCR's) will be used only to propose revisions to the FYDP when revisions could not be processed through the POM procedure and provided the change will

(1) increase military readiness significantly and is considered urgent enough to warrant out-of-cycle review; or

(2) impacts on health, welfare, or morale; or

(3) coincides with OSD-directed or fact-of-life program changes. As stated in the draft instruction: "POM's must represent a comprehensive and detailed expression of the total resource requirements."

While this proposed procedure is a radical change from the present method of obtaining program changes through the PCR system, it does serve to highlight the urgent need in AMC for more detailed, precise cost data and on the continuing need for timely information upon which decisions can be reached.

In summary, I am certain that you all are aware of the growing concern that the nation and the Congress have expressed relative to the percentage of the Federal Budget that is spent on defense matters. One need only read the morning paper to sense the tenor of the times and to realize the trends in DOD pertaining to increased emphasis on economy. Certainly as a taxpayer, I want the nation to have the best possible defense for the least reasonable cost. Also as a military manager, I want to insure that the dollars made available to the services are invested in the best possible equipment to do the jobs that must be done. Competing requirements within the defense establishment for the resources made available by the Congress demand that each service continuously review the validity of its respective resource needs and state such needs clearly to DOD.

In order for AMC to effectively provide "what the Army will fight with," it is essential that we refine our techniques and procedures to insure that the resource requirements submitted to DA and DOD represent the best possible cost estimate for the system being considered. This is clearly a job of management improvement and being able to identify, specifically, what is needed to do the job. To improve the AMC management capability, greater visibility in our business is essential so that problems may be surfaced sufficiently early to provide for logical solutions.

AMC is critically aware that to successfully accomplish its mission, it must continuously improve its management skills. New procedures have and will continually be refined that will provide the information

needed at each management level to assist in the decision process.

In conclusion, the CG of AMC has accepted a challenge to "manage better with less." To accomplish this objective, we recognize the urgent need to continually work towards developing improved procedures and techniques for better management and control.

Further, we recognize that in order to successfully accomplish

the AMC mission during periods of austerity, managers at all echelons must be alert to those indicators which signal problems, and, having identified the problem, take positive corrective action. AMC is oriented toward improved methodologies and more effective management through greater visibility and improved control.

## **NOTES**

### **SECTION III**

### **INSTALLATION**

### **MANAGEMENT**

# REACHING THE GOAL OF IMPROVED INSTALLATION MANAGEMENT

BRIGADIER GENERAL HUGH R. HIGGINS  
DEPUTY CHIEF OF STAFF, COMPTROLLER  
HQ. U. S. CONTINENTAL ARMY COMMAND

**I**t is gratifying to be able to provide this article for several reasons. First, the students of the Army Installation Management Course represent an audience of professional managers with a desire for self-improvement. Second, installation management is currently an object of the personal interest of my boss, General James K. Woolnough, the CONARC commander, and his boss, the Chief of Staff of the Army. Third, the CONUS Installation Management Study, which is now being implemented, will draw upon the talents of the Army Management School to achieve its ultimate objective — the improvement of installation management. Keep in mind that one of the major considerations in the study is the qualification of installation management personnel. By completing the Army Installation Management Course, students are improving their qualifications. Most of my remarks will be directed toward this study, but let me lead off by telling you what CONARC does and what we manage.

General Woolnough's mission can be summarized as follows.

First, he is responsible to the Army Chief of Staff for administering the command structure and for providing administrative and logistical support. General Woolnough is a major field commander of the Department of the Army.

Second, he is the Army component commander of the Strike Command and of the Atlantic Command.

Third, and possibly most important, he educates our military and civilian personnel and operates the training establishment.

Fourth, he administers the Reserve components.

As you see, installation management is not a stated mission. It is, however, implied, for the quality of these functions is dependent on the quality of the management of the installations at which they are performed.

During an average day, some representative personnel strengths are these: military (permanent party) — 350,000; transients, replacements, returnees, and those being separated — 67,000; patients — 8,000; trainees — 169,000; and students — 79,000, making a military total of 673,000. There are also about 105,000 civilians on the payroll. For the year, our training load will be 900,000 students and trainees. They are educated at 16 training centers and 26 service schools.

We have 65 installations — 41 active, 4 inactive, and 20 active and inactive sub-installations. Forts Belvoir, Benning, Sill, Lewis, and Carson are among the active installations.



To indicate the magnitude of our Reserve mission, the Army National Guard consists of 378,000 and the US Army Reserve of 1,298,000, making a total of 1,676,000.

Now, let me get into the Installation Management Study. I will confine my remarks to an assessment of the impact on CONARC.

The study was a result of General Westmoreland's noting that there is a need to institutionalize management at class I installations. This gives commanders an opportunity to accomplish their primary mission, and still give attention to managing their industrial and community activities. Industrial activities include maintenance of real property, supply, and other logistic services. Community functions include operation of dependent schools, service clubs, open messes, and recreational activities.

Reorganization appears to be the most important element of the study in that it occupies the most space

and portrays standard organization charts. We consider its impact, comparatively speaking, minimal, because it really doesn't change things very much. Titles at the principal staff level are different, but their definitions of functions remain basically the same. Perhaps the most significant change is the elevation of the post engineer to the principal staff and the configuration of the communications-electronics functions at corps and division posts. These two officers become members of the Program Budget Advisory Committee.

Briefly, organizations are standardized into four types, according to the installation mission. There are two type A installations within CONARC. These are Fort Bragg and Fort Hood. By definition, type A installations are those on which a corps headquarters is located.

Here the tactical headquarters Chief of Staff looks to a deputy installation commander for the super-



BRIG. GEN. HUGH R. HIGGINS

Gen. Higgins received his B.S. degree from Ohio State University in 1942, when he was commissioned a second lieutenant. He received his master's degree from the University of Michigan. He is also a graduate of the Command and General Staff College, the Armed Forces Staff College, and the Industrial College of the Armed Forces.

Gen. Higgins joined the staff of CONARC in Dec. 1968 in his present capacity. Prior to that, he was assigned to the DA staff as Chief of the Budget Division under the DCSPER.

(This article was adapted from Gen. Higgins' presentation before the Army Installation Management Course at USAMS on 3 Oct. 1969.)

vision of installation support functions.

Next is the type B installation which supports a division headquarters. Forts Riley and Carson are the only type B installations. The organization for types A and B installations are very similar in that, where feasible, both tactical and installation functions are performed by the same staff offices.

Type C organizations comprise the bulk of CONARC's installations. These are installations without major tactical organizations or major command headquarters.

All of them have modified director staffs under the command of a chief of staff/deputy installation commander.

The six installations supporting CONUS army and CONARC headquarters are Fort Meade, Fort Monroe, Fort McPherson, Fort Sam Houston, Fort Sheridan, and the Presidio of San Francisco. These are type D installations, that is, they are installations on which major command headquarters are located.

These differ only slightly from type C installations. They are not normally commanded by general officers, and they have an executive officer who functions as the deputy installation commander.

The study recognizes that "no one standard organization will satisfy perfectly all situations," and that "installation commanders must have flexibility in tailoring organizations to meet situations unique to their local environment." So much for organizational aspects of the study.

We consider the real impact to be in five recommendations; these are so interrelated that they must be considered as a family. They are: 1) provide positive command emphasis on the DA Work Measurement Program; 2) develop a set of

management indicators for use at class I installations in monitoring the performance of installation support activities; 3) determine the feasibility of periodically providing class I installations with CONUS-wide averages or goals for use in analyzing the management indicators developed as a result of the recommendation above; 4) publish guidance in accordance with the concepts expressed in the study for use by the CONUS armies and MDW in establishing new or additional requirements for their class I installation's periodic review and analysis; and 5) provide subordinate commanders guidance to insure that management improvement goals are stated in measurable, finite, and specific terms.

I will discuss performance factors, work units, and indicators and explain how current work measurement techniques provide the foundation for implementing these recommendations.

To set the stage, let's define a "management indicator": a statistic which is used as a measure to express the relationship between programmed performance and actual performance.

Through the Army management structure, and the Work Measurement Program we can identify indicators that are presently applied. However, these two systems do not encompass all of the functions or management levels that must be represented. It is in this area that we must develop additional indicators.

Now let's see how the management technique of work measurement is and can be used as a tool for installation management, and how indicators are developed at the basic work level through the application of work measurement techniques.

Guidance by General Westmoreland, which is a basic element of the philosophy underlying the recommendations, is quoted here: "... in the development and establishment of the concept of competition between installations, impetus must be provided to activities such as work measurement, work standards, and production control."

It is the involvement of these activities in the study that I want to discuss.

Here are definitions of the terms "work measurement" and "work standard." Work measurement is an interrelated group of techniques for measuring the amount of work accomplished or to be accomplished, and for developing a time standard for performing work of acceptable quality. A work standard is that which is set up and established as a rule for the measure of quantity, weight, extent, value, time, or quality.

A work standard is the result of the application of work measurement, so the two are compatible.

The data provided from work measurement is used for production planning, scheduling, and control; programming and forecasting; *determining operating effectiveness*; isolating areas for attention; *determining manpower, fund, and equipment requirements*; providing a basis for incentive; *comparing methods*; *providing review and analysis data*; and providing information for reports. (The italicized areas will provide the most benefit to installation commanders when applying the CIM study concept.)

Keep in mind that the use of work measurement does not cause any new or revolutionary actions to be started. It proposes that the results of work measurement be used for improving management. This is accomplished through the expansion of the Army manage-

ment structure. The functions, which make up the top level management structure, are as follows:

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AMS CODE	FUNCTION
2000.0000	Operative Forces
2100.0000	Training Activities
2200.0000	Centre Supply
2300.0000	Depot Activities
2400.0000	Medical Activities
2500.0000	Army-Wide Activities
2600.0000	Army Reserve & ROTC
2800.0000	Intelligence Activities
2900.0000	Army-Wide Communication/ IV ACTY
9000.0000	Base Operation

The base operation function contains most of the industrial operations that are discussed in the study. I will follow this structure down to the installation level and show how it relates to work measurement.

The functional areas shown below show a more defined code breakout. The performance factor, which is used as an indicator, is gross and not representative of the true accomplishments. Indicators at this level will have to be developed to better represent these functions.

There are approximately 3,000 variations of these codes used regularly within CONARC to account for resources.

Within the 9040 code for base services, we find the industrial operations of a class I installation. Management indicators will have to be developed; however, the managers of each of these functions can identify the indicator they use to determine the amount of work accomplished, such as number of telephones installed in the communication function, or the amount of meat processed in the food program. Then, the amount of work accomplished and resources expended must be documented and reported.

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AMS CODE	FUNCTION	PERFORMANCE FACTOR
9000.0000	Base Operation	Population Served
9010.0000	Supply Operations	None
9020.0000	Maintenance of Materiel	Population Served
9030.0000	Personnel Support	None
9040.0000	Base Services	Population Served
9050.0000	Operation of Utilities	Square Feet
9060.0000	Maintenance of Real Property	Percent of Total Costs
9070.0000	Minor Construction	None
9080.0000	Other Engineering Support	Population Served
9090.0000	Administration	

In the following, I will illustrate how an indicator is developed through the application of work measurement.

Up to this point, I have followed the Army management structure. Here, a transition takes place, and the code is expanded at the installation to incorporate a work measurement identification. Also, at this point, there is a term called "work unit" which identifies the work accomplished in each element.

This expansion of the coding structure allows for the organizational elements to be broken into homogeneous work areas. This is where the work is accomplished, the resources expended, and the work standards established. This is also where the indicator is related to the operation, and this is where the standards for comparison come into being.

Each work area is defined with one or more work units, and for each work area there is a manager who uses this work unit as his "indicator" to determine how well his personnel are performing.

It is from this basic working level that we are able to collect raw data and pyramid that data upwards through the management structure. This data is incorporated into planning and support documents for review and analysis, budget, manpower, equipment, and workload requirements. This data is also used to support management indicators that may be used at installation and higher levels.

To review how work measurement data is collected, computed, and summarized for review by each manager, a monthly report is made by the first-line supervisors at the installations. After the respective AMS code, the actual number of personnel used for the month is shown. Let us assume the work unit is "pants pressed" to represent a particular work area of the pressing operation. The work standard developed for how long it takes to press one pair of pants is 54 seconds. The number of pants pressed for the month may be 96,000 pairs, whereas the manager planned to press 120,000, a workload based on trainee guidance received from the CONARC operating program. The operating program states that the average daily trainee load for a certain training center is 25,000. Experience shows that, for this strength, there are 120,000 pairs of pants to be pressed each month. Since only 96,000 were processed, there is a 20% deviation from the amount programmed. About 1,420 man-hours were used to press the 96,000 pants. The number of man-hours that should have been used, based on the work standard, is 864. This variation causes the percent of effectiveness to fall to 60%. The plant operations supervisor consolidates the effectiveness of all work areas and arrives at an overall effectiveness indicator of 97%.

When the percent of effectiveness exceeds 120% or falls below 80%, there is a companion form that ac-

companies the monthly report. This companion form is a statement of analysis, identifying a problem area, the cause of the problem, and the corrective action taken or required.

The laundry manager can now compare his operations with other designated standards. These standards may be the ones developed by Department of the Army, such as contained in the appropriate technical manual. The work measurement technicians adjust these standards to fit the local situation.

Some actions that influence the validity of a standard are: new methods, improved equipment or procedures, the skill of the work force, and overage/shortage of personnel.

A methods improvement study is usually accomplished prior to setting standards. Methods studies can be exchanged between installations, and will help to find the best method of accomplishing the work.

A composite report of the laundry can now be made to the Director of Industrial Operations. This report shows the effectiveness of the laundry through the use of computations. The Director of Industrial Operations is able to summarize all of his functional areas, where work measurement is applied, into a single report. The indicators may again become less definitive, as the summary pyramids towards the top management level. It is at the higher levels that we must develop a separate or composite type of management indicator.

Work measurement is not applied to all organization segments, but only those where repetitive or industrial-type work is performed.

From the base services account, we can summarize at the total installation level. This identifies the functional areas where work measurement has been applied, and re-

flects a gross effectiveness indicator for these functions and the installation.

This is another level where we must determine and develop meaningful management indicators.

Examples of additional indicators used at most installations that are not derived directly from the Army management structure or work measurement programs are the AWOL rate, the Savings Bond participation rate, and reenlistment.

The Department of Army has developed standards for use in the repair and utilities function of post engineers. The indicators are adaptable, and are used at installations today.

Up to this point, I have attempted to relate how the Work Measurement Program operates, to show how the existing processes and structures at various management levels can be used to implement the study. We propose to take advantage of existing programs to the fullest extent. It is planned to continue the Work Measurement Program at the 24 installations where there are currently some 100 work measurement spaces and personnel. Since no resources will be provided, the 17 installations that do not have a Work Measurement Program will have to generate spaces from within their existing strength.

The CONARC Work Measurement Program was evaluated in 1968. It consists of nearly 150,000 military and civilian positions -- to be measured through work measurement. To date, we have measured 40,000 of these positions. The 242,000 authorized positions are comprised of the military and civilian TDA spaces and do not include TOE strength. It was determined that we needed 372 spaces for work measurement personnel to complete the program in a five-year time frame.

CONARC has been attempting to establish the program and use this technique since 1966. The problem that faced us then is the same problem that faces us today — a lack of sufficient personnel resources.

In summary, I would like to quote General Westmoreland:

"Through the uniformity that will result from implementation of the study recommendations, a basis for comparison of installations with like missions will be possible. Professional competition between these posts can be developed through application of management indicators, exchange of information as to methods, procedures, and innovations followed. This will challenge commanders to exercise initiative in meeting competition from other installations and the innovations developed. In the development and establishment of the concept of competition between installations, impetus must be provided to activities such as work measurement, work standards, and production control."

General Woolnough employs the management-by-exception technique. He assumes everything is on track unless the staff highlights significant deviations or critical problems, which have a direct bearing on the execution of the mission. In CONARC, we try to retain the "vertical visibility" necessary to meet the requirements of centralized management. We have indicators

to reflect the degree of attainment of key programs. This enables the CONARC staff to keep track of how we are doing and flag the programs that are in trouble.

We authorize and encourage decentralized responsibility to subordinate commands. In this regard, school commandants and Army commanders have latitude in directing, coordinating, and controlling resources to achieve their objective.

One of the current efforts is to develop a reporting system which gives "vertical visibility" to the CONARC staff and Army commanders, and "horizontal visibility" to the installation commander. We want to develop a means through the review and analysis system to use the data collected by the Army management structure and other areas. These include installation operation of the post exchange, Army community service, general educational development, dependent schools, chaplain, open messes, and non-appropriated funds. We will have to develop management indicators by means other than work measurement. Once a system is developed, we will request reports on selected data and use this to provide data to installations for comparative analyses.

We must develop a systematic program for converting statistics generated by activities into simple, comprehensive pictures for the installation commander.

# MANAGEMENT FROM THE VIEWPOINT OF THE CHIEF OF STAFF

BRIGADIER GENERAL D. V. RATTAN,  
CHIEF OF STAFF,  
XVIII AIRBORNE CORPS  
& FORT BRAGG,  
FORT BRAGG, NORTH CAROLINA

In order to discuss management and how I, as a Chief of Staff, must use and direct this leadership principle, let me first give you a background of my job and my place of business.

Fort Bragg is a sprawling collection of military units, community services, business functions, and residential areas. The post has 51,000 military men, 7,300 civilian employees, 48,000 military dependents, and 11,000 retired servicemen. We live near the city of Fayetteville and border on Pope Air Force Base. We have our own training areas, drop zones, and Army airfields. We house troops in barracks and families in quarters, and train, feed, educate, doctor, and support a large city — giving us typical and unique situations to deal with daily.

Fort Bragg has a 31-year history and is noted as the "Home of the Airborne." Beginning as a field artillery training camp, World War II changed Camp Bragg into the staging and training area for newly formed infantry divisions that entered combat by parachute. The 82d Airborne Division, the first airborne division, returned to Bragg in 1946 and is the major tactical unit presently assigned to XVIII Airborne Corps.

As one of the major Army tactical headquarters, XVIII Airborne Corps is responsible for the preparation of plans to support the possible commitment of Army forces almost anywhere in the world. This responsibility dictates the requirement for a planning staff within the headquarters to be continuously engaged in the task of preparing, updating, and refining the vast array of plans to cover all possible types of military contingencies. Such contingencies may range from the provision of a small medical team to perform a mission of mercy in some remote village in an underdeveloped country, to the commitment of major combat forces. Our obligations made it apparent that we must tailor our military response to fit diverse situations in widely varying localities. Consequently, we need strategically mobile forces designed to respond on short notice to meet any threat. It is from this requirement that XVIII Airborne Corps derives its mission: to move by air on short notice to any part of the world, prepared to fight upon arrival.

As part of our domestic mission, the XVIII Airborne Corps and its units have played a prominent role in civil disturbance operations. The Corps and its units were deployed

## NOTES



to Detroit and Washington in 1967 and to Washington and Baltimore last year. In each case, we were able to react rapidly and employ appropriate forces necessary to gain control and establish and maintain law and order.

To successfully manage and control all the units, missions, and functions required at Fort Bragg, the Commanding General must divide his staff into two areas of responsibility — the corps staff and the installation staff. Some staff members have dual responsibilities and some specialize in a particular function.

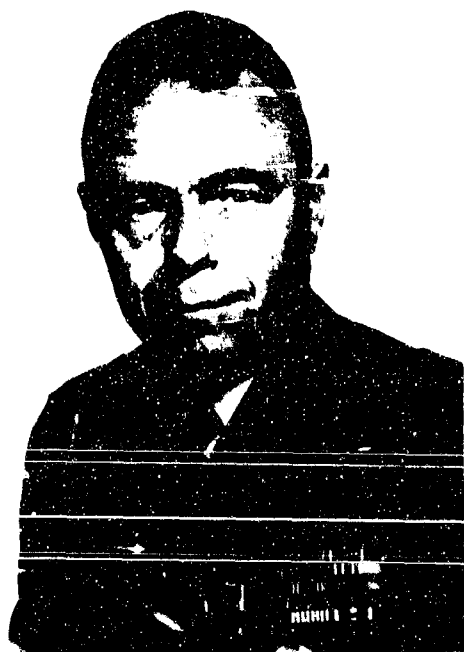
Figure 1 is the basis really for the rest of my discussion. The chart itself is pretty much self-explanatory, but I would like to make a few remarks concerning some of the areas indicated on it.

Figure 1 represents our current organization at Fort Bragg. The organizational picture, as you see it, was developed by General Westmoreland when he was the corps/

post commander several years ago. It may not come as a big surprise to learn that recently Department of the Army has directed that all posts like Bragg, i.e., class I installations with a corps headquarters and major units, be organized in this manner. This really hasn't caused us much trouble, as we have been organized pretty much like this for the past three years.

The Commanding General wears two hats — he is the Corps Commander and the Post Commander. Should the corps be deployed, he would go with it.

The Chief of Staff likewise wears two hats, and as a matter of practicality, really has an unofficial third one. The third hat is that he is, in effect, the Deputy Commanding General of the corps. That doesn't mean that he gives orders to the Commanding General of the 82d Airborne Division, but it does mean that he is the rating officer and supervisor of certain units such



**BRIG. GEN. D. V. RATTAN**

Gen. Rattan is a graduate of West Point, the Army Infantry School, the Command and General Staff College, the Armed Forces Staff College, the NATO Defense College, and the Army War College. He holds a master's degree from George Washington University.

He became Chief of Staff of the XVIII Airborne Corps in Aug. 1968. Prior to that, he was Executive Officer of the Special Warfare School. Earlier, he had completed a year's tour in Vietnam, where he commanded the 1st Brigade, 1st Cavalry Division (Airmobile).

(This article was adapted from Gen. Rattan's presentation before the Army Installation Management Course at USAMS on 22 Oct. 1969.)

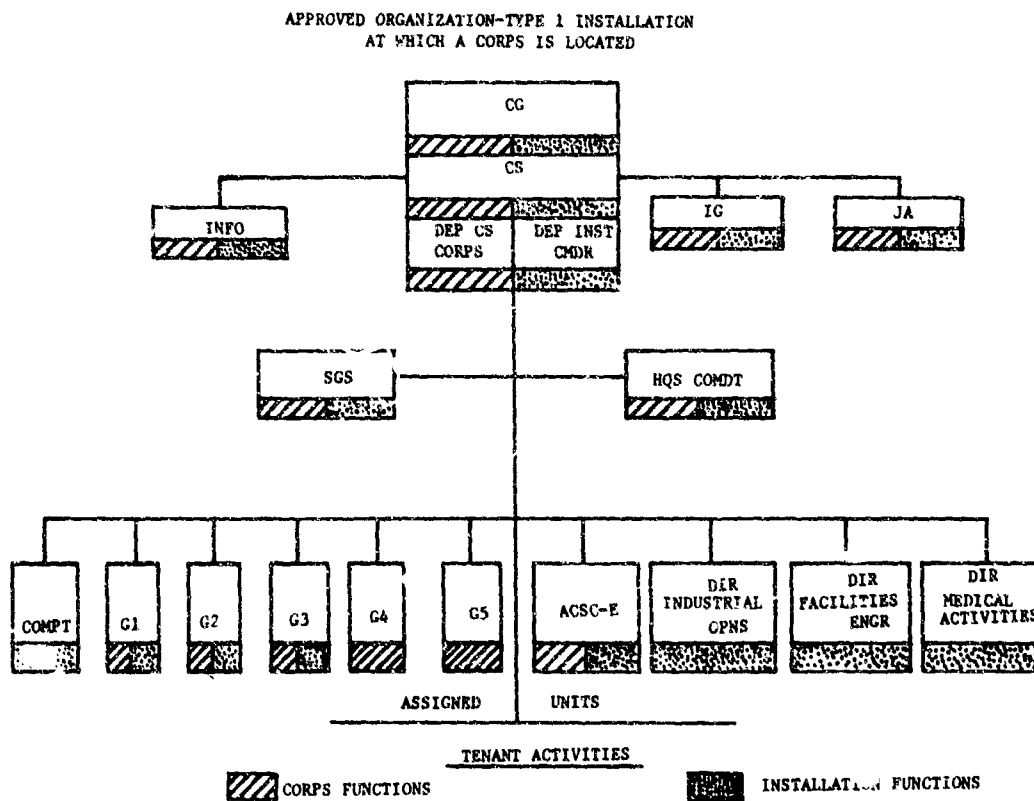


Figure 1.

as Corps Artillery, our MP Group, and our Signal Group.

Next, we have the two gentlemen who work directly for the Chief of Staff. The first of these is the Deputy Post Commander. He is, in effect, the city manager and, in the broadest terms, is responsible for the day-to-day operations of the post. He is concerned with such matters as law and order, police, and really almost everything except strictly tactical or training matters. He has one lieutenant colonel as his assistant; but other than that, he gets his normal work done through the integrated staff and the integrated SGS.

The Deputy Chief of Staff devotes the bulk of his time to corps activities. He is more directly concerned with such things as training, readiness of units, and contingency plans.

The SGS and Headquarters Commandant perform normal functions.

Now, skipping to the lower part of Figure 1, the functions of most of these sections are pretty normal, so I won't comment on them. However, there are a couple of them that deserve a special word.

You will note that our Corps G-4 is not integrated with the Post G-4. Actually, we don't have anything labeled Post G-4. But if you will look at the block that says DIO, which stands for Director of Industrial Operations, i.e., the Post G-4, these two sections are split out, as the size of the post and its logistical-type activities, such as maintenance, services and transportation, are so extensive that it was just not practical to merge this operation with the Corps G-4. For this reason, the Corps G-4 is separate, small, and concerns itself primarily with contingency plans and various outloading plans.

I don't have to tell you people here at the Management School

that, to a considerable extent, the post is run in the manner in which the Commander wants it to be run. I don't say that it is run exactly as he wants it to be run, because it is just too large and complex with too many detailed regulations in effect for one man to be able to run it exactly as he wants to.

At any rate, I want to give you a brief rundown on my boss, as it has a big impact on Fort Bragg. My boss is Lieutenant General John J. Tolson. Prior to arriving at Fort Bragg in August of 1968, he had commanded Fort Rucker for a period of two years and had been the Assistant Commandant before that. In brief, although the units on the posts are certainly different, he was well aware of all the headaches to be encountered in running a class I installation.

Now that background is very different from that of the Chief of Staff — me. I became Chief of Staff some twelve days after General Tolson became the Commanding General and I immediately attacked all the problems that faced me with only limited experience upon which to base my decisions. I had never had anything whatsoever to do with running a post, and although I had commanded a brigade in Vietnam, the last time I was assigned to a unit on a post was as a company commander at Fort Bragg twenty years ago.

I found that understanding and giving guidance on the corps side of the house was really not difficult — these were the tactical, training, or contingency plan types of decisions I had been exposed to throughout my Army career, both in schools and in the field. However, I was horrified at the complexity and never-ending stream of problems generated by the post side of the house. On this side of the house you get involved with every-

thing from Commissary, PX, Teen Club, carnivals to raise money, as well as running the Stockade, wild-life conservation, Engineer road maintenance, dependent schools, integration of local schools, labor unions, and really an almost never-ending list of similar items.

With that as a bit of background, let me talk now about how things actually work. First of all, take the blocks in Figure 1 labeled Commanding General, Chief of Staff, Deputy Chief of Staff, and Deputy Post Commander. I think of these as the command element. All of the command decisions are made at this level. The tricky part here is in getting to know the amount of authority delegated to you by the man above you. The amount of authority delegated to me by General Tolson, or by me to my two deputies, is really not something you can reduce to writing. As far as I am concerned, I feel a responsibility for everything that happens at Fort Bragg and through association with the Commanding General for the last fifteen months, I pretty well know when I can make decisions without checking with him and when I should not. My two deputies are in about the same boat. One thing that I would emphasize, however, is that if anybody in this command element chain of command is absent and a decision is needed, whoever is left has the authority to make decisions as they are needed. He might get nibbled on later for not making the right decision, but he will not get nibbled on because he made a decision. I think that this point is very important, because if you don't have people in the command element that are willing and able to make decisions, you will bog down the whole post and end up with a lot of nice papers and a lot of things that don't get done.

It is part of my job as Chief of Staff to "manage" people into the right jobs, to get the best performance from them for the corps and to help further their career. When I think of management, I recall an old story from Army history. During the old days of the Artillery, horses were used to draw cannons and wagons. It was the habit of a particular gunnery sergeant to let a young private hold the reins while a wagon was being loaded, until the load began to get heavy. Then the old sergeant took over the driving because the horses could pull more with the experienced hands holding the reins.

With horses or with men, the ease with which the load is moved is determined in large part by who holds the reins, and how they are held. A skillful driver knows how to communicate to the team by means of the reins, his voice, manner, etc. He makes accomplishment easy, because the members of the team are then able to coordinate their effort and to work in unison. Even horses soon learn to have confidence in a capable master. They know that he will not ask anything impossible or unreasonable. But they also know that he knows what the maximum effort is of which each is capable, and that he will not tolerate a balky or a lazy horse who would destroy team efficiency.

When the sergeant held the reins, the horses were at their best. Then they were organized and united. Their spirit was at its peak. They knew that the one holding the reins acted in their best interests. It is the same with a good executive/leader. The members of the units are inspired by his ability, fairness, and purpose. The unit is stronger than the total strength of the individual members. For each has his own strength, but he also draws

from the strength of others, including the leader.

In closing, the Chief of Staff can best manage by showing concern for the mission, the organization,

and the people. And since the mission and organization are fairly constant, concern for the people doing the work deserves study, effort, and experience.

# INSTALLATION MANAGEMENT AT FORT KNOX

COLONEL HAROLD W. KASSERMAN.  
ASSISTANT CHIEF OF STAFF.  
COMPTROLLER.  
U. S. ARMY ARMOR CENTER.  
FORT KNOX, KENTUCKY

The original invitation from the Army Management School received at Fort Knox was addressed to a fellow officer, requesting that he describe his role as an installation Chief of Staff and provide a summation of his philosophy of management. Unfortunately, that officer was prevented from complying, and he suggested that I present his views.

Now, without question, this exaggerates my acquaintance with his daily activities. However, a Comptroller usually becomes quite knowledgeable of the Chief of Staff's leadership style in a very short period of time, and I don't believe that I am an exception.

The Army Management School has consented to the change and has gone so far as to also invite me to express my own views on installation management. For me, this is an opportunity that is much appreciated.

General Sutherland, Commanding General of the U. S. Army Armor Center, and Colonel Jack L. Baithia (for whom I am substituting) asked that I mention that the Armor Center has supported the Army Management School over the last several years with guest speakers and information because we value highly the training that senior staff officers have acquired there.

The frustrations and pressures encountered today by individuals assigned to a major staff position on a large installation are extremely severe — and these are not idle words. The Army Management School has provided a number of Fort Knox staff officers with information and training that has been of material assistance, particularly in the management of resources during periods of austere operations. Austere operations, as you all know, seem to be a way of life these days.

In order to describe Fort Knox management actions, I think it would be helpful to first tell something about our installation and activities — in other words, I'll attempt to describe the reasons we have jobs here. I'll also briefly discuss what I believe to be the most significant current problems. Then I'll describe the staff organization and management concepts the Armor Center uses to accomplish its mission.

First, let me describe Fort Knox.

Fort Knox is located 35 miles southwest of Louisville, the principal city of Kentucky, and is pretty well isolated from any large community. This isolation has both its advantages and disadvantages. Although we do not have the problems of installations immediately adja-

cent to a big city, transportation of employees, for example, and an adequate network of roads present some difficulties.

The reservation measures 14 miles from north to south, 18 miles from east to west, and contains 110,351 acres. There are 66 firing ranges where we fire weapons which range in caliber from a BB gun to the Shillelagh gun launcher.

The ranges are used around the clock. Some figures in this area might interest you. Our inventory of class V contains 484 different items and is valued at over \$10,000,000. In an average day, we shoot 64 tons of ammo valued at about \$90,000. In a year, this amounts to over \$23,000,000.

On the reservation, there are 216 miles of improved roads, 19 miles of Army railroad, and over 3,800 government-owned buildings. Fort Knox is the Army's second largest installation with respect to these

items, bowing only to Fort Richardson, Alaska.

In addition to military traffic, civilian buses and taxis operate on the post, as well as over 20,000 privately owned automobiles. We enjoy the customary traffic and parking problems experienced by any community of this size.

We can house 4,370 families in assorted types of individual homes and multiple dwellings, and we can billet 1,547 bachelors in various type of BOQ's, some of which, I must say, are obsolescent.

Under the supervision of, and financed by the Federal Commissioner of Education, we operate our own school system for dependent children living at Fort Knox. This year there are over 5,000 children enrolled in our dependent schools, which range from kindergarten to a modern high school and include a school for the mentally retarded.

The current population of the Armor Center is approximately



COL. HAROLD W. KASSERMAN

Having enlisted in the Army in 1940, Col. Kasserman was commissioned a second lieutenant in 1942, serving until 1946. He returned to active duty in 1947 and attained his present rank in 1966.

Col. Kasserman has had a series of assignments in the finance field -- Comptroller at West Point, Budget Officer with the Ryukus Command, Assistant Finance Officer with HQ Eighth Army in Korea. Other finance assignments have taken him to the Pentagon, Fort Belvoir, and HQ 9th Air Force.

(This article was adapted from Col. Kasserman's presentation before the Army Installation Management Course at USAMS on 24 Sep 1968.)

39,500 military, 6,600 civilian employees, and 14,600 family members, for a total of about 60,900 persons.

Now let's take a look at our organization. We have a dual chain of command from Department of the Army through CONARC to the Commandant of the Armor School, and, parallel to it, from CONARC through First Army to the Armor Center. The CG wears three hats — as Commandant of the Armor School; Commanding General of the Armor Center; and Commanding General of Fort Knox.

I will briefly describe the missions of the most important of the subordinate elements of the Armor Center.

The Armor School trains leaders and technicians, both officer and enlisted, on the organization, equipment, and doctrine for Armor units. One special course of interest is the Armor Noncommissioned Officer Candidate Program, which began training in December 1967 and is producing NCO's of very high quality. This has been a most successful course.

During Fiscal Year 69, the Armor School trained 12,352 students and is programed to train about one thousand more next year.

The United States Army Training Center, Armor, has a six-fold mission. First, it is responsible for the overall operation of the Reception Station. This station is one of 11 presently in operation in the country, and receives, directly from civilian life, an average of about 3,800 men monthly. The mission of the Reception Station is to test newly inducted personnel and process them to the Training Center. Second, the Training Center provides basic combat training for newly inducted personnel. Third, it provides Armor and Reconnaissance Advanced Individual Training.

Fourth, it provides combat support training for clerks, clerk-typists, personnel specialists, radio operators, and cooks. Fifth, it trains personnel for 4 to 6 months under the Reserve Enlistment Program. Sixth, it operates the First Army Noncommissioned Officer Academy, which includes a Drill Sergeant and a Drill Corporal Training Program.

The Training Center has an average daily training strength of approximately 13,500, and during FY 69 graduated over 78,500 trainees. The programed input for FY 70 is over 92,000 trainees.

A provisional Aviation Group was activated at Fort Knox in December 1966. This group has trained three squadrons of Air Cav, which have deployed to the Republic of Vietnam. We still have one Air Cav Squadron.

Our 194th Armored Brigade provides troop support for the Armor School and supports Armor Center Contingency Plans. This is a STRAF unit with a secondary mission of school support.

Presently, the 194th Armored Brigade contains four tank battalions, a mechanized infantry battalion, an armored artillery battalion, an air cav squadron, and necessary combat support units.

The Ireland Army Hospital at Fort Knox, opened in 1957, has a 500-bed capacity, and is one of the most modern medical facilities in our part of the nation.

Fort Knox is also responsible for the operation of three Support Detachments, in Cleveland and Cincinnati, Ohio, and in Oakdale, Pennsylvania. These detachments support air defense units. We also provide logistical support, supplies, and services for a complex of 1,200 active and reserve units located in 140 different cities in the states of Ohio, Pennsylvania, Indiana, West Virginia, and Kentucky.



In calendar year 1969, over 24,000 Reserve and National Guard personnel trained at Fort Knox and were supported with billets, training areas, and all types of equipment.

There are several other units at Fort Knox which are not under the Armor Center, but which receive support and occupy our facilities.

First, the Armor Agency of the Combat Development Command. The mission of the agency is to determine how Armor should organize, equip, and fight in the future.

The Armor and Engineer Board is an agency of the Army Test and Evaluation Command. It performs service tests and advises on type classification of new equipment, to include armored vehicles, automotive ignition systems, and engineer equipment.

The Medical Research Laboratory is the second largest research activity of the Medical Research and Development Command, Office of the Surgeon General. The chief areas of research are blood transfusion, biochemistry, vision, biophysics, toxicology of snake venom, and pathology of animal disease.

The Armor Human Research Unit is under the direct control of CONARC and conducts studies and research in training devices, and motivation and leadership techniques, with primary emphasis on Armor requirements. The bulk of its research is performed by civilian scientists, from George Washington University, who work in conjunction with military personnel.

The Maintenance Board is a field agency of the Army Materiel Command. Its mission is to conduct studies and research on ways and means to improve Army policies on organizational maintenance, technical service field maintenance, and parts supply. The famous PS mag-

azine is a function of the Maintenance Board.

And last, but not least, and probably the most publicized activity at Fort Knox is the Bullion Depository — commonly known as the Gold Vault. Controlled by the US Treasury Department, it was established at Fort Knox in 1937. There is still a sizeable amount of gold stored in this depository in spite of the publicity concerning our loss of gold during recent years.

The Armor organizations on Fort Knox are all linked in one aspect. The Commanding General of the Center, who is also the School Commandant, serves as Chairman of what we call the Armor Panel. At some other centers it is called the Center Team. This Panel is made up of the Commanding General of the Training Center, the Commanding Officer of the Armor Agency, the President of the Armor-Engineer Board, and the Commanding Officer and Senior Scientist of HumRRO. As a group, they consider the whole spectrum of Armor operations — training, doctrine, materiel, human engineering, and maintenance. A coordinated position on all these subjects is then presented to Headquarters, Department of the Army.

At this point, I have told you a little about Fort Knox and briefly described the organizations located there. I will now attempt to tell you something about our efforts to accomplish the tasks that I have just outlined.

The Armor Center Headquarters uses a general staff organization — and I may be describing a vanishing Indian. Apparently, we will be directed in the near future to adopt a directorate-type staff; however, I'm certain that the problems we are facing will remain the same.

In a recent article in a Louisville newspaper, the Fort Knox Chief of

Staff was described as "the man in the middle." It appears that this outsider's view is fairly accurate — and I imagine is a fairly astute observation of the Chief of Staff's role in either a general or directorate staff.

A description of organization will best show the Armor Center Chief of Staff's responsibilities.

There are three lines of authority up and down from the Commanding General. One goes from the Commanding General to the major commanders. Another goes to the Armor School. Still another goes from the Commanding General to the Chief of Staff, and under him are the general and special staff offices of the headquarters.

The Commanding General must depend upon his commanders to execute their missions. He depends, for example, on the Assistant Commandant to operate the Armor School, under established guidelines.

The Chief of Staff's role is to direct, coordinate, and control the staff, which includes 21 staff activities, 6 general and 15 special. There are 3 personal staff activities that report to both the Commanding General and the Deputy Commander. The Chief of Staff is also the Deputy Commander. These are the IG, Information Officer, and the SJA.

The general staff officers are the principal assistants to the Chief of Staff. They plan, coordinate, and give direction within their assigned area of responsibility. They also are responsible for coordinating with other members of the general staff.

The Chief of Staff's job is to see that the general staff has direction, and that performance is at an acceptable level. He must ensure that each staff element has adequate plans for the future, an effective in-

ternal organization, enough resources to execute assigned missions, and the capability of providing the command with adequate and accurate information.

The organization of a class I installation is receiving an immense amount of recent attention. As I mentioned, the CONUS Installation Management Study will, we hear, result in the establishment of a "directoriate staff" and also change a number of existing staff relationships. The elevation of the Engineer to a principal staff status, for example, is a major change.

I think it important to note here that organization change is not a revolutionary concept. Organizational relationships are almost always in a state of change. They must adjust to new problems, and, to new commanders. There are many examples.

We're still working on Commo-Electronics, our 6th General Staff office. Recently we were directed to consolidate all photographic facilities. We're waiting for an approved TDA to officially set up MEDDAC — which apparently will become another principal staff element. We've moved Family Housing all over the chart, G1 — Special Staff — Engineer — and now G4. We've heard that CONARC is reestablishing the QM and Transportation offices which were consolidated with Signal into a Services Organization a few years ago.

As these examples indicate, we have adjusted, or at least attempted to adjust, to new ideas and requirements. Our current organization is working well and serving our needs; however, we recognize that it could be improved.

I think I can safely say that The Armor Center will generally welcome a shift to a directorate staff. While not in consensus, most staff members consider that the oppor-

tunity for all staff members to contribute is improved under that arrangement.

My next subject concerns the problems we are currently encountering. The first three are the most significant problems of general interest. None are new and I'm certain most, if not all, installations face the same difficulties.

Our No. 1 problem last year was funds. Our No. 2 problem was personnel. Our No. 3 problem was growth, or increased mission.

These, by no means, represent the entire picture. There are many other problem areas that require management actions. For example, confinement facilities at Fort Knox are relatively inadequate; therefore, the stockade, and its associate, the Special Processing Detachment, receive considerable attention. Military personnel apprehended in a five-state area are brought to Fort Knox for processing. These people, largely AWOL's, must be received seven days a week — any time of day. Each case must be established — and this is often a difficult task, as their records are sometimes almost impossible to acquire. Unless these cases are handled quickly, the population of the stockade goes too high. If these people are paroled, many again depart — and we have the task to do over when the escapee shows up in custody at Fort Knox again.

Other examples of problems are:

1. Unexpected changes to our programmed training load.

2. Are the Army's ear plugs effective? Do trainees suffer a hearing loss?

3. Have we unknowingly permitted some chicanery in our non-appropriated fund area — or have some other installations?

4. Can we absorb new requirements in the Training Center, such as new combat engineer vehicle

training? Can we switch from .50 caliber to 20 mm cannon on M114's?

5. What will be the effect of a coffee-house newly established in a neighboring small town?

These, and many areas, have required management actions at Fort Knox; however, the big item on the horizon is the possible material reduction in resource availability that has been in the news during recent weeks. I don't think there is any doubt that this, and, situations generated by austerity measures, will require a major share of our management capability.

Actions taken by the Armor Center last year to alleviate a similar, but probably less serious situation, will undoubtedly be repeated to a major extent.

It might therefore, be useful to describe FY 69 experience.

FY 69 was a bleak year from a resource point of view. Our minimum essential requirements were \$80.88 million. Our annual funding program was \$65.47 million. We were short \$15.41 million at the beginning of the year. Most of the \$15 million deficit lay in BP 2100 (Training), our carrier program.

The deficit was so large that there was no doubt at all command levels that some aspect of our operations would have to be curtailed. In September, we determined the specific items that had to go if the \$15 million shortage continued to exist.

Our plan, titled Disaster Plan No. 1, called for complete curtailment of costs that could be managed. Included were: TDY, schooling, new hire of civilian employees, contracts for maintenance and custodial service, purchase or replacement of equipment, and separation of temporary employees.

In addition, we asked for authority to separate 1,000 employees, divert trainees scheduled for training, discontinue Project Transition

and tuition assistance, cancel ADP contracts, and terminate security guards at one off-post facility.

The product was a possible reduction in requirements of \$13 million and a crippled installation. It took 12 pages of single spaced text to summarize the impact of these austerity measures.

On 6 Nov. 1969, First Army advised that DA planned to balance mission and funding. Manpower was not considered. We were told to continue all on-going training and essential support and to take proposed austerity measures only to the extent necessary to operate within the revised guidance. The result of this guidance was that funds ceased to be the No. 1 problem and personnel became first on the list.

Our personnel story isn't unique — this is a difficult situation that is shared by most installations. The problems of FY 69 continue to exist and, without question, will worsen as further personnel cuts are made.

We started FY 69 with a shortage of 948 that grew to 2,447 during the year. During the same period, our requirements grew to 15,105 as a direct result of the acquisition of new missions.

Along with other installations, we received a substantial cut in manpower during FY 69. We were cut approximately 11% of total; however, the cuts were concentrated in support areas. We were not permitted to reduce the School, Training Center, Comm Center, Medics, Family Housing or Training Aids. Staffing of these areas was directed.

In order to live with the situation, we set up Disaster Plan No. 2. Our first step was to assign personnel from TDA units to TO&E units, and then detail them back to their old jobs. This, of course, was an expedient. We knew attrition would quickly take these personnel, and it

has. Second, we transferred missions and functions to TO&E units or used them to augment TDA activities. Third, we had to cut down training schedules for TO&E units. Fourth, we asked for and have used more civilian overtime. Fifth, we're rationing our civilian hire authorization in order to fill essential positions only.

Our difficulty was that we were trying to balance missions and funding; however, we could not add personnel to the balancing action. This problem has not been resolved, and, in fact, grows more serious as further personnel cuts are made.

Next to funds and personnel, I believe our third largest problem is our growth. We recently acquired responsibilities in a five-state area and now have a major support role for active Army and Reserve units located in these five states.

We started with Kentucky. Then we added one support detachment in Ohio whose major mission was to provide field maintenance and engineer services to an Air Defense Command unit. Then we added two more detachments and assumed more new missions when the corps headquarters were closed.

No doubt, the changes were sold by developing estimated savings and projecting these savings into the future. We're sure some personnel were saved, since we were required to absorb a substantial workload and were not provided the related staffing.

We have had some difficulty adjusting to these new tasks. Some management actions in this area may be of interest.

First, we developed a manual, showing the organizations supported and how we came by the assignment. If there's any doubt, we have a reference point.

Second, the G4 was assigned the task of planning and coordinating

the assumption of these new missions. The acquisition of real estate and providing the basic logistical services was the major task, and, of course, it was in his area.

Third, we organized teams of personnel to orient our new commands and to help them make the adjustment to our systems.

Fourth we conducted a number of studies to see if assignments of responsibilities could be made more equitable.

One problem that still plagues us is the distances involved and the time lost traveling. The other problems, we believe, are being overcome, refined, or eliminated as our experience grows.

Our method of allocating and managing resources is my next subject.

First, I'd like to say we receive all kinds of help from several sources. There are always bits of guidance from special interest groups, special projects, ceilings, floors, etc. Both funds and personnel are frequently earmarked for special purposes.

First, let's examine the system. Funds are passed through Comptroller channels from command to command. Personnel are passed through G1 channels from command to command. New missions are passed through various technical channels and are seldom tied together. Theoretically, these factors — mission, funds and personnel — are related by the PBAC actions at the various headquarters. In actual practice, they seldom are related in the same time frame and almost invariably we have trouble personnel-wise.

Our PBAC consists of the G1, G3, G4, Comptroller, and Surgeon. The Chief of Staff is Chairman. Our areas of responsibility are standard based on the Army Management Structure. When funds and per-

sonnel are received, the Comptroller and G1 advise the Chief of Staff as to the initial impact of the authorization documents in our areas. The task is to ration or distribute our shortages. Someone has to divide the resources between the major activity directors in order to get the ball rolling.

It has been our policy to make an initial distribution of resources to the major activity directors, give them guidance, and then examine what has to be left out.

The things to be left out, curtailed, or deferred become our unfinanced requirements. This is the committee's most important function, since committee or staff action assures that we're all proceeding in the same direction.

Another important committee action relates to establishment of priorities, or which unfinanced requirement is top priority and how the rest are arranged in sequence.

The third and most time-consuming function of the committee is the process of keeping tab on our status, evaluating progress and compiling our monthly and quarterly reviews.

These analyses indicate what we should do in the future, what actions are needed, and how well we have done. Of course, these are not the only meetings. The Chief of Staff meets with the staff weekly and the CG conducts a monthly Commander's Conference. In many instances, we meet and discuss matters more frequently than once a month or once a quarter. We believe, however, that a coordinated evaluation on a quarterly basis is required to present the overall picture, and to permit the commander to make effective decisions.

Our PBAC actions are presented to and approved by the CG before they're implemented.

Frankly, at Fort Knox the PBAC works more as a general staff than as a committee. The chairman, contrary to most rules for committees, has decision authority and uses this authority rather than ruling on actions by majority vote.

Next, I want to discuss our management philosophy, or as the Army Management School put it, "our preferred leadership style."

At installation level, a commander's primary interest is concentrated on accomplishing his mission, and lately his principal concern has been making both ends meet. He must be able to turn out an acceptable product — with the resources he receives or has.

As I mentioned, we are organized under the General Staff concept.

We operate primarily on the management-by-exception concept, using our operating program, budget, and other plans as a basis for exception management. While this concept doesn't give you firm control over everyone and everything, it produces better results with less frustrations. It also gives command time to concentrate on its mission and the future.

We believe in progress, and if there's a chance to improve our operations, organization or reduce costs, we'll do it. We don't believe in change for the sake of change. Any change should be proven profitable before implementation.

Most senior staff officers today are a bit dubious about all of the systems we're using to improve our operations and the increasing number of specialists we must have to operate these systems. The number of systems we're being faced with is up over the past few years and their relative effectiveness hasn't been as great as forecasted. Yet, they consume productive time, cost money, and haven't solved our personnel and funding problems. In

some cases, the new systems have presented serious road blocks to operations. To mention a few:

The TAADS System (Army Authorization Document System) has stagnated our TDA's. For example, it has taken 8 months to switch 4 TDA spaces from one activity to another, even though we were directed to make the change by higher headquarters.

Resource management — a highly touted system — still is consuming time and effort, but isn't off the ground yet. Our first efforts to hold expenses, including military pay, in line was a fiasco. Our wheels have spun for two years on this project and we're still spinning.

The use of computers and new systems involving standardized operations requiring computer support seem to encounter delay after delay. Our inability to effectively mechanize our administrative actions, since we must wait for COCOAS, is, without question, preventing us from taking advantage of the benefits of automatic data processing at an early date.

In short, some improvements haven't helped us.

We have made some progress in the use of work measurement, and we plan to expand our efforts in this area. Unfortunately, when the primary factors used to determine the number of personnel to be used are the availability of funds and spaces, it is difficult to interest operators in such items as work measurement.

They are quick to tell you that they have far less than staffing standards allow and inefficiencies are therefore unavoidable.

I hope that my comments have provided some insight into the type of management actions that are going on at a class I installation today. I have attempted to be frank and to honestly describe the situa-

tions we deal with on a daily basis.

Please note that a discussion of this type inescapably deals with problems. The Armor Center enjoys many successes, but under the

management-by-exception concept, I did not discuss them here.

In spite of many problems, the Center continues to turn out the finest fighting men in the world.

## **NOTES**

## **SECTION IV**

### **INDUSTRIAL MANAGEMENT**



# NEW MARKETING MANAGEMENT HORIZONS

MR. JACK E. GIECK  
DIRECTOR OF MARKETING  
DIVERSIFIED PRODUCTS DIVISION  
FIRESTONE TIRE & RUBBER CO.  
AKRON, OHIO

**T**he industrial psychologist, Dr. Mortimer Feinberg (who has lectured at the Army Management School), says there are three ways for a man to go to ruin — liquor, women, and farming — and his father picked the most boring of the three.

Actually, there is a fourth way — at least for the manager of a business — or a marketing manager — and this is for him to let the daily pressures of his job keep him from doing what, in my opinion, is one of his primary functions as a manager. This is the process of occasionally shutting his door, putting his feet up on his desk, and thinking about such questions as—

What business am I really in today?

What business should I be in (if I were as smart five years ago as I am now)?

And, extrapolating from this, what business should I be in five years from now?

Where is there going to be money to be made?

What should I be doing about it — now?

But this problem of defining what business you are in isn't as easy as it sounds. Anybody who thinks he is in the business of making light bulbs, for example, has been in seri-

ous trouble since 1939, when he began losing his commercial market to fluorescent lights; he has since lost street lighting and outdoor illumination to mercury and sodium vapor lamps; more recently, he has lost theatre, motion picture, and optical equipment lighting to quartz-halogen and zirconium arc sources; and, in the next 10 years, he is probably going to lose much of the home market to panels which utilize the electroluminescence of conductive glass. But if, on the other hand, he thinks of himself as being in the illumination business, he will already be where the action is.

For a hundred years, the railroads thought they were in the business of operating trains. And they nearly died. Had they realized they were in the transportation business, they might have done things differently, especially beginning in 1935 when the Federal Motor Carrier Act was passed.

Since they didn't join them (and diversify), they could still beat the airlines at their own game. They could haul you from downtown Detroit to downtown Chicago in comfort in two hours, instead of the 3½ hours it takes on a plane (including ground transportation and the waiting period at both ends). And they could do it on trains without wheels — today the

technology is available — if they weren't intellectually constipated.

The point is that I am firmly convinced that successful, market-oriented businesses are not based upon products, but upon customer needs. Marketing is not just a big word for sales. Marketing is the anticipation and satisfaction of human wants, for profit. The marketing viewpoint is, or should be, a way of life for a business — it is something like systems engineering. It includes market research, product development, sales promotion, selling, advertising, and distribution.

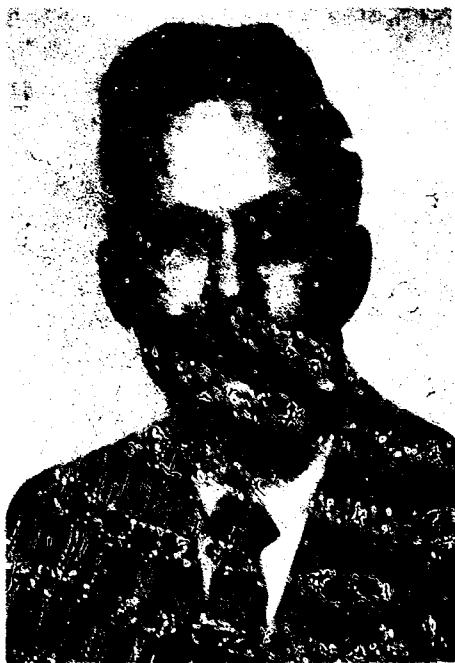
Another way of looking at it is to ask the question, what materials, or skills, or strengths do we as a company have that can be turned into something people need, and will want to buy?

A real pioneer new-product-oriented marketer who may have invented this philosophy was Andrew S. Hallie. Hallie was a wire

rope manufacturer in San Francisco, a hundred years ago, who wanted to expand his business. Well, San Francisco is a very hilly town and people had a hard time getting around. So, in 1873, Hallie invented the cable car; and, incidentally, spawned a subsidiary, the Clay Street Railroad Co. And because he had produced a major innovation with patent coverage, he had the market all to himself until 1890, when Leland Stanford began giving him some competition. By that time, the whole city was cobwebbed with cable car lines and the wire rope company was cranking out hundred of miles of replacement cable a year — at several dollars a foot!

In our company, at Firestone, we have defined some corporate goals that call for doubling our sales and profits in the next five years — that comes out 15% a year. And this applies to all our divisions.

But in our Diversified Products Divisions we make everything from



MR. JACK E. GLECK

Mr. Gleck is a registered Professional Engineer who received his B.S. in Chemical Engineering from Iowa State Univ.

He has been associated with Firestone for over 20 years in such capacities as product development engineer, product manager, automotive engineer, and general manager.

Mr. Gleck is also a writer and filmmaker.

(This article was adapted from Mr. Gleck's presentation before the Army Installation Management Course at USAMP on 22 Sep. 1969.)

textile denier Nylon to stainless steel beer barrels (of which, incidentally, we are the largest producers in the world.) And serious analysis of some of these divisions will reveal that they are not going to achieve this kind of growth just by selling more of what they presently make — just by arbitrarily upping the quota of the sales department by 15% each year. This is particularly true in businesses like our Steel Products Company where many of the automotive trim parts this division makes are being replaced by plastic. So, if they can't expand their market for their present products, they are going to have to come out with new products. And here is where the cheese begins to bind.

I think a very important rule in assessing any new product venture is that it must use some of the company's strengths like Andrew Hallidie and his wire rope. In our present-day economy, nearly all of Minnesota Mining's new products, for example, have been related in some way to 3M's ability to make chemical coatings. Incidentally, that highly successful company plows 4% of every sales dollar into product development, which I think may be a lesson for all of us.

Another marketing concept that has been helpful to us in expanding our businesses through new products is the concept of adding compatible products to our existing product lines. Compatible products are products which serve the same common market. Like transistors and vacuum tubes. Razor blades and toiletries. Polyurethane foam and latex pincore. Mattresses and pillows.

Nobody would expect a salesman to sell transistors and razor blades. They are sold into completely different markets, and to completely

different people. What I am really talking about, regarding the concept of compatible products, is amplifying the power of an existing selling organization with very little additional sales expense. Just by adding products that are sold into the same market — or, better yet, to the same buyer.

In a way, this concept is related to systems selling. Systems selling is the business of selling a complete package to a customer.

On a retail level, in Akron, we have National Office Supply on West Market that sells, in addition to office furniture, office machines, typewriters and adding machines, stationery supplies, pencils, lead, ink and erasers, paper, and even framed pictures to hang on your office wall.

On an industrial basis, systems selling might include machine tools and spare parts, plus drill bits, grinding wheels, sandpaper belts, cutting oils, and wiping cloths, I suppose.

Our Firestone Coated Fabrics Co. sells water management systems that include Fabridams, Fabritanks, attendant plumbing, and complete systems engineering.

I think that, like Andrew Hallidie, in planning the future of our businesses we have to have the courage to take innovative steps that have the potential of radically altering the course and complexion of the whole company.

Peter Drucker puts it this way: "The job is not to impose yesterday's norm on a changed today; but to change the business, its behavior, its attitudes, its expectations — as well as its products, its markets, and its distributive channels — to fit the new realities."

In most companies there is considerable inertia at all levels when it comes to introducing new prod-

ucts. Partly, this is the result of the myth that the overwhelming majority of new product ventures are failures.

This isn't quite the case. A survey of 51 top companies undertaken by Booz, Allen and Hamilton shows that, although the mortality rate on new product ideas is high, with a well-managed product-development program, two-thirds of all new products introduced are successful. Such a well-managed program ordinarily includes the disciplines of exploration, market research, business analysis and screening, product development, market testing, and commercialization.

There are other natural resistances to innovation in any organization. In the first place, most people are too busy with today's crisis to have time for tomorrow's plan. The other reason is a little more subtle. Arthur D. Little has said that "Radical change, if it comes about, threatens many people. In the stable corporate society, many talents are developed to deal with the production and sale of familiar products, and people are rewarded, or punished, in terms of how well they perform their familiar tasks. But what if a radically new product is introduced, one requiring new manufacturing technology, a new approach to sales, a new standard of individual performance which even management cannot yet determine? It is only natural, in the culture of the corporate society, to put aside the risk of the unknown."

So, if we are willing to face up to Peter Drucker's "new realities," we have to make an effort to find out what they are going to be like — so that we can plan for them. Because of the nature of my job, I have personally made a study of what the professional forecasters

are predicting for the next 5-7 years, as has our Market Research Department, and I would like to share the distillate of these studies with you. And some of it is pretty heady stuff!

If we avoid a major war, and most people believe we will, life in 1973 will be a "swinging" society — with more money, more recreation, more emphasis on the youth psychology — the sort of thing that causes guys in their 40's and 50's to go skiing on weekends. And not only youth psychology. One out of every four people ever born is alive today, and in the United States over 40% of them have yet to reach their twentieth birthday.

The work week is expected to decline to 37 hours. The recreation market, consequently, will get bigger. Domestic travel expenditures should increase 50% (which is one reason the tire business will grow almost twice as fast as the automobile business) and international travel is expected to grow by 60%.

We will have the most educated population ever known to mankind. By 1972, 21% of adults will have attended college. The education market is big. There will be considerable demand, for example, for programmed learning and other teaching devices. The information market, electronic data processing, and integrated cybernetic controls will have expanded unbelievably. They will undoubtedly revolutionize post office procedures, to name just one of their impacts.

To the chagrin of most of us, there will be increased involvement of the Federal Government in all of our lives, in such diverse areas as automotive safety, international communications, air traffic regulation, waste management, and air pollution control — and certainly controls are needed in a number of these areas. Conservation is an-

other related market. So is the health market — and this market is primarily in sophisticated, computer-controlled information systems to aid in diagnosis and in the management of illness on an individual basis. Mass transportation is arriving right now. Energy will continue to be a rapidly expanding market. So you say, What has that to do with your own business? Well, one of our divisions, for example, is considering bringing out a line of wire spools. You don't have to be in the primary market to take advantage of its opportunities.

One horizon market is oceanology — and just to give you a mind-expanding drug, so to speak, a magazine as practical and conservative as *Machine Design* points out that, although man has always been merely a random hunter of the seas, now —

"Confronted by the increasingly acute food shortage on land, pioneers in the science of aquaculture have plans to raise fish, shellfish, and even plants by plowing the sea, warming areas by atomic energy, fertilizing and weeding the ocean, and fencing off underwater farms mechanically and electronically."

By 1980, oceanology is projected to be an 8 billion dollar market.

I have heard it suggested that the 1930's were the age of chemistry, the 1940's were the age of physics, the 1950's were the age of electronics, the 1960's were the age of mathematics (and the computer), and the 1970's will be the age of the social sciences.

If so, there is money to be made in this market, as U. S. Gypsum has demonstrated in providing dry-wall for the new interiors of old homes in urban renewal projects.

Now, I know a lot of this sounds a little "blue sky," but I submit that this is precisely the kind of

thinking that a marketing manager, or manager of a business, has to do conscientiously if his business is to be anything but an "also ran." And it's a pretty fast field. The rate at which technological change is taking place is exponential in character.

Most of you have probably seen a plot of how fast man has been able to travel versus how long he has been around — or how high he could fly. These curves were both practically flat until a century ago and have been turning up at a faster rate every decade since.

The same thing, I am convinced, is true in industrial product technology. One of the most spectacular examples is how the number of electronic circuits that can be packed into a cubic foot has changed in the last 40 years:

First-generation vacuum tubes in the 1930's — 100/ft<sup>3</sup>;

Second-generation transistors in the 1950's (already obsolescent) — 1,000/ft<sup>3</sup>;

Third-generation micro-miniature integrated circuits, 100,000/ft<sup>3</sup>.

A 16-bit logic circuit, encapsulated in plastic, for a computer contains 32 transistors and 24 resistors. The circuit itself is contained in an area .005" square and .001" thick. There are 300 of them on a wafer.

To take a more mundane example, the light meter I used to take movies with when I was in high school had a maximum emulsion speed of 64. Nobody expected any film ever to be faster than that. The fastest Super X, B, and W was about 32 at that time. Today there are color films with speeds of 3,000, and a light meter advertised in the current *American Cinematographer* will handle ASA speeds up to 25,000.

In our own business at Firestone, more than two dozen of the Diversi-

fed Products plants have their entire business based on materials which did not even exist 25 years ago. More than a quarter of 3M's sales come from products developed within the last 5 years.

About 90% of the 4,000 drugs in common use today were developed within the last twelve years. One of these — oral contraceptives — just might be the best answer to the mass transportation problem I discussed earlier.

### [ Summary ]

I have talked about the marketing concept as a way of life for a business; the concept of adding compatible products in expanding a product line; systems selling; and using company strengths.

I have listed what I believe to be important markets in the next 10 years: energy, the youth market, recreation, education, conservation and antipollution, information (data control), mass transportation, the health market, and oceanology.

I have given an overview of the changing requirements for industrial materials in the next 10 years.

But, mostly, I have emphasized the importance of keeping a company alert enough — young enough — responsive enough — to be where the action is.

I'd like to conclude with some words said a couple of years ago by former Secretary of Health, Education and Welfare John W. Gardner:

"I have collected a great many examples of organizations that have fallen on evil days because of their failure to renew themselves. And I want to place before you two curious facts that I draw from those examples. First, I haven't yet encountered an organization that wanted to go to seed or fall behind in the parade. Second, in

every case of organizational decline that I know anything about, there were ample warning signals long before trouble struck. And I don't mean warning signals that only a Monday-morning quarterback could discern. I mean that before trouble struck, there were observers who had correctly diagnosed the difficulties to come.

"Now, if there are plenty of warning signals, and if no organization really wants to go to seed, why does it ever happen? The answer is obvious: Eyes that see not, ears that hear not, minds that deny the evidence before them. When organizations are not meeting the challenge of change, it is as a rule not because they can't solve their problems, but because they won't see their problems, not because they don't know their faults, but because they rationalize them as virtues or necessities.

"The moral is clear. If an institution — be it a corporation, a government agency, or a school — wants to move with the challenge of the times, wants to avoid the rapid obsolescence that overtakes the somnolent today, it must ask itself some uncomfortable questions: 'What are the criticisms that we have refused to listen to? What are the faults that we have been rationalizing away? What are the things that we just won't change because we have a vested interest in keeping them the way they are?'

"And if I had to give you one useful rule in seeking the answer to those questions, I would urge you to listen shrewdly and realistically to your critics. Not all criticism is sound — not by a long shot. But some of it is priceless. And when we ourselves cannot see our problems because habit, vested interest, defensiveness, and self-justification stand in the way, then our critics can perform a significant service for us."

# MANAGEMENT CONCEPTS IN INDUSTRY

MR. JAMES E. KNOTT,  
MANAGER, PLANT OPERATIONS,  
ALLISON DIVISION,  
GENERAL MOTORS CORPORATION,  
INDIANAPOLIS, INDIANA

I have appreciated the opportunity to prepare for this talk this afternoon because it was a challenge to express clearly in a relatively few minutes the operating philosophy of a fairly complex industrial organization. I have taken literally the guidelines set forth by Colonel McLean, and therefore my discussion pertains directly to the suggested subjects. The exact nature of the responsibilities of this group is somewhat new to me; therefore, my remarks may not be directly related to your work. I will describe how an industrial organization functions and hope that you will be able to glean from this certain principles and operating techniques which will prove useful when you return to your normal assignments.

At the outset, I will describe the nature of our business and the type of organization that is used, because any organizational structure should reflect the complexity of the business. I believe the Allison Division business can be called complex because it embraces all functions, such as sales, engineering, procurement, manufacturing, and product service. Furthermore, the business is divided between commercial and defense, involving at least three completely separate product lines. Allison is also a division of a corporation, which adds an element of

complexity because of the responsibilities we have to our Central Office in Detroit.

The organizational philosophy used herein will be based principally on good commercial practice, and if time permits, I will briefly explain my opinions of the differences of operating a defense business and a completely commercial business.

General Motors is a classically functional organization, strong on financial control and the development of management people, and is extremely responsive to its customer's needs and to public opinion. Figure 1 is only a part of the complete General Motors organization structure, but is shown to locate the Allison Division in the Non-automotive and Defense Group. All divisions are in some way located under a Group Executive in order to evenly spread the operating responsibilities and to relieve the load on each Executive Vice President. Each division is headed by a General Manager, who in some cases is also a Vice President of the Corporation.

You are well aware of the diversification of products and the worldwide structure of General Motors, and its organization has been tailored to result in adequate attention to problems, as well as prompt and intelligent decisions by the up-

per management group. There are 33 divisions, occupying approximately 170 plants in 23 countries, with a payroll of about 760,000 people.

The Allison Division organization is quite similar in principle to other General Motors divisions, regardless of the product; but as you would expect, each division must vary somewhat from an "ideal" organization to reflect many special problems associated with the design and marketing of the product. To avoid confusion, I would first like to show you what could be considered a basically functional division chart (Figure 2), and then quickly show you how the Allison Division deviates from this chart because of our different product lines. Figure 2 shows ten basic functions normally found under a General Manager. The upper grouping of six is, in most cases, considered a staff function, which means

a service to the operating departments shown on the second level. The usual variations to this might combine Purchasing and Material Control, and in some cases Engineering and Research.

Figure 3 shows the current Allison Division chart, and it differs in the areas shown by the double outline. Allison's growth has resulted in three separate product lines for both commercial and defense customers. The Cleveland plant is responsible for track-laying vehicles and the customer is the Army. The plants in the Indianapolis area are divided into two plant complexes, one being responsible for heavy duty powershift and automatic transmissions for both commercial and Army vehicles; and the other Indianapolis plant is responsible for aircraft gas turbine engines and the customers are commercial, Army, Navy, and Air Force.



**MR. JAMES E. KNOTT**

Mr. Knott was graduated from the University of Michigan in 1938 with a degree in Aeronautical Engineering. In the last 30 years he has pioneered in almost every phase of aerospace propulsion development after joining the Allison Division in 1940. Prior to that time, he was a flight engineer with Pan American Airways Transatlantic Division.

Since joining Allison he has served in many managerial capacities including installation engineering, sales engineering, military requirements, assistant sales manager, and director of engineering. In Sep. 1969 he was named Manager of Plant Operations for the plants located in Indianapolis and Cleveland.

(This article was adapted from Mr. Knott's presentation before the Army Installation Management Course at USAMS on 21 Oct. 1969.)



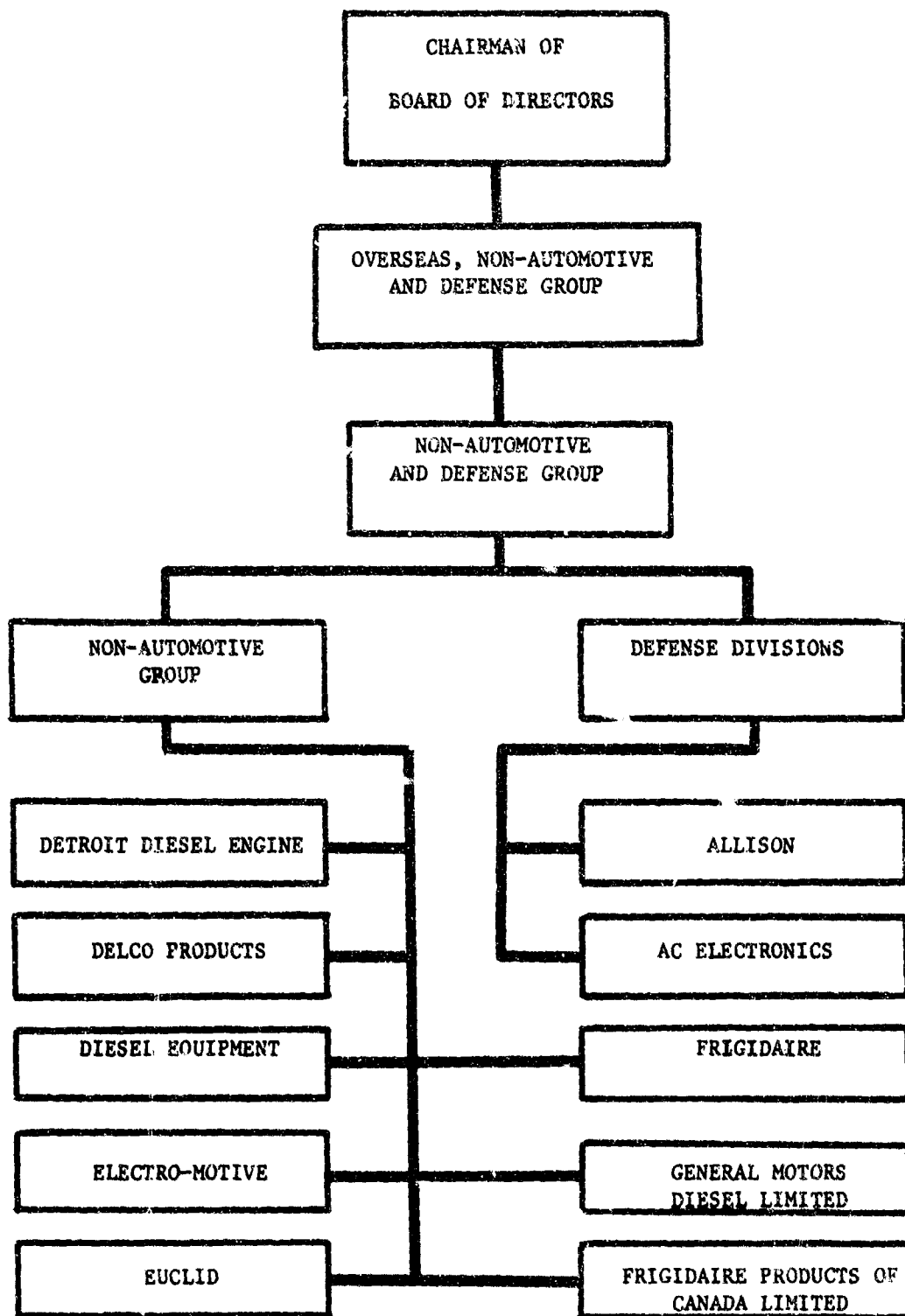


Figure 1.

To insure the close control of these product lines, and at the same time spread the load below the General Manager, it was decided to appoint three Plant Managers, who are responsible for their specific product lines as shown. Because Purchasing and Product Assurance are division-wide functions, there are benefits to having a universal policy which can best be administered from the General Manager's office. On an everyday basis, the product-related part of each function does report through each Plant Manager to maintain continuity of administration. As I have already observed, the other staff functions perform a service, as required, to the three Plant Managers.

One further deviation in the organization is the use of a Program Manager for the TF41 turboprop program for the Defense Department. Whereas Allison is a firm believer in line organizations with clear-cut responsibility, this program is a large, single program and involves a major subcontractor in England. A Program Manager was deemed advisable principally as a communication channel and to expedite the many aspects of this program not normally incurred with our product lines.

Figure 4 provides a picture of the division of Allison's 1969 sales, showing that overall defense business accounts for 64% and commercial 36%. To look at it another way, in Indianapolis only, the aerospace business accounts for 49%, and the transmission business 29%. The military track-laying vehicle (tank) business in Cleveland is 22%. The organization just described occupies 7 plants, totaling almost 9,000,000 square feet (of which 6,500,000 is General Motors-owned), and the payroll approaches 18,000. This very brief description of our organization should provide

some base from which you can relate the necessity of the organizational philosophy and techniques which I will describe.

I will now take up the subject of organizational philosophy, and as has been suggested, I will discuss both centralized and decentralized procedures. In the case of a division of a corporation, there is no choice of which type to use, inasmuch as a corporation must necessarily require certain functions to be centralized for adequate control; but must also permit as much decentralization as possible in order to encourage forward development, manufacturing, and sales progress. Innovation thrives better in an organization which has direct responsibility for sales of its product line.

Listed below are the functions that should be centralized in a corporation of this size. By far the most important one is financial control, and this is followed by personnel administration, legal and patent work, and finally public relations and advertising. At the bottom I have made reference to Standing Committees, which are characteristic of General Motors, and these several committees, responsible for specific centralized functions, meet once a month. In this sense they must be considered part of a centralized organization.

Financial control, which starts with the Corporation Comptroller and the Finance Committee, is concerned principally with the control of cash, or cash flow, as well as capital investment for land, buildings, and equipment. Operating expense items such as major engineering projects are, by necessity, under central control. Accounting procedures and audits, along with annual budget approval, are a necessity and finally the general subject of property control.

# MANAGEMENT CONCEPTS IN INDUSTRY

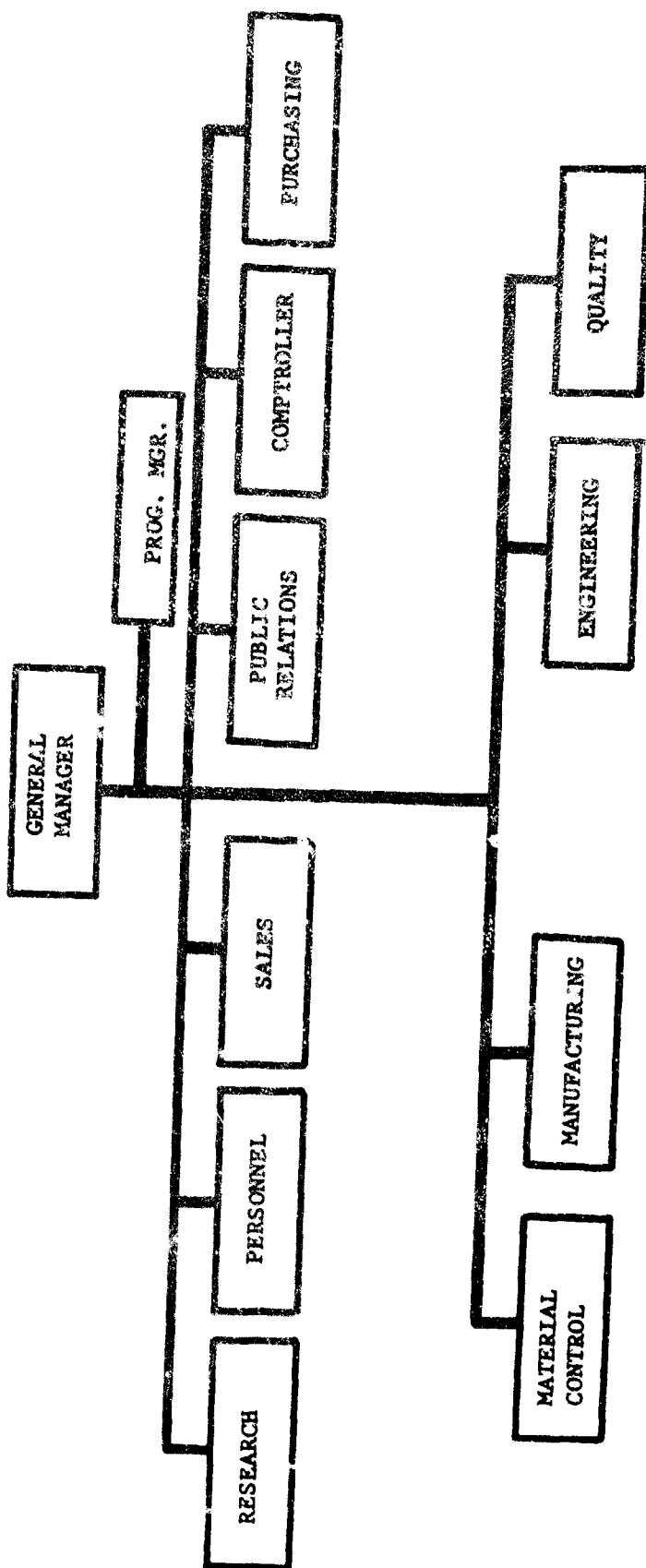


Figure 2.

**CENTRALIZED FUNCTIONS**

- **FINANCIAL CONTROL**  
(FINANCE COMMITTEE-COMP-TROLLER)  
CASH CONTROL  
CAPITAL INVESTMENT  
MAJOR EXPENSE ITEMS  
PROCEDURES & AUDITS  
BUDGET APPROVAL  
PROPERTY CONTROL
- **PERSONNEL ADMINISTRATION**  
UPPER MANAGEMENT  
LEVELS ONLY
- **LEGAL AND PATENTS**  
NEW GOVERNMENT CON-  
TRACT TERMS AND CON-  
DITIONS — SUITS
- **PUBLICITY AND ADVERTISING**  
(EFFECT ON CORPORATE  
IMAGE)
- **STANDING COMMITTEES**  
MONTHLY OPERATING RE-  
VIEWS

I am sure it is obvious to you that a corporation with at least 170 plants located in 23 countries must carefully watch the acquisition of land and buildings, and more importantly, how these buildings are utilized. This plan recognizes a certain amount of flexibility in transferring production between plants, depending upon available capacity. This prevents some plants from working overtime because of undercapacity while at the same time other plants may be partially idle due to overcapacity.

Personnel administration must, by necessity, be centralized, since a large part of General Motors is devoted to the manufacture and marketing of automobiles and trucks, and therefore there is considerable depth in its management which can be utilized throughout the corporation by transfer. Furthermore, because General Motors operates with a national labor agreement, all divisions and their local labor force must conform to the national agreement.

General Motors is strong on the development and encouragement of

of its management personnel and therefore closely controls the progress, salary increases, promotions, and transfers of its principal people. There is a level of management above which all such matters must receive approval from the Central Office Group Executive, or possibly even the committees. This, by necessity, maintains some uniformity in the development and appraisal of these people.

The Legal and Patents Staff is centralized as a convenience and a more effective pooling of talent, since the demand on this group fluctuates widely from division to division. A centralized group can respond very well to divisional requirements, and there is a considerable savings in total staff required to do the job.

Public Relations and Advertising are centralized primarily to provide a coordinated and unified approach to matters that could affect the corporation reputation. Advertising is one medium by which this is accomplished. The individual divisions cannot independently establish their own policy when collectively they contribute to the overall corporate image.

I will now identify the decentralized functions which I have listed below. As you would expect, the responsibility for the everyday operation of the plant, including its product problems and its relationship to the community and to the customer, is in the hands of the General Manager.

Purchasing policies are product-related and therefore properly reside with the individual divisions. This is not to say that there is not some pooling of purchasing and close coordination between divisions that purchase large quantities of similar material. It happens that at Allison we are unique users of the more exotic, light-weight,

**DECENTRALIZED FUNCTIONS**

- EVERYDAY OPERATION OF PLANT
- PURCHASING POLICIES
- QUALITY ASSURANCE POLICIES
- SALES & SERVICE POLICIES
- TECHNICAL PLANNING & DECISIONS
- PROPOSAL PREPARATION AND CONTRACT NEGOTIATIONS
- ALL PERSONNEL AND ORGANIZATIONAL MATTERS BELOW THE "UPPER MANAGEMENT" LEVEL

heat-resistant materials used in our aircraft engines, and these are purchased in relatively small quantities (by automotive standards). Furthermore, we must adhere to Defense Department regulations in our purchasing practices, which involves more administrative detail and records, and hence more cost than would be needed for a similar commercial product line.

Quality assurance policies are related directly to the product line and the requirements of the customers, which for Allison involves the Defense Department. It is possible that certain inspection techniques and equipment might find universal use among several divisions, but the quality standards must be maintained individually.

Technical planning and decisions involving engineering and research matters are related to the division's product line, and it would be extremely difficult to apply any universal standards to other product lines. The division is free to plan its engineering programs; however, as previously stated, the approving of funds or the procurement of expensive test equipment requires Central Office approval. Furthermore, although it is not specifically stated, a division would not be permitted to deviate significantly

from its traditional product line without Central Office approval.

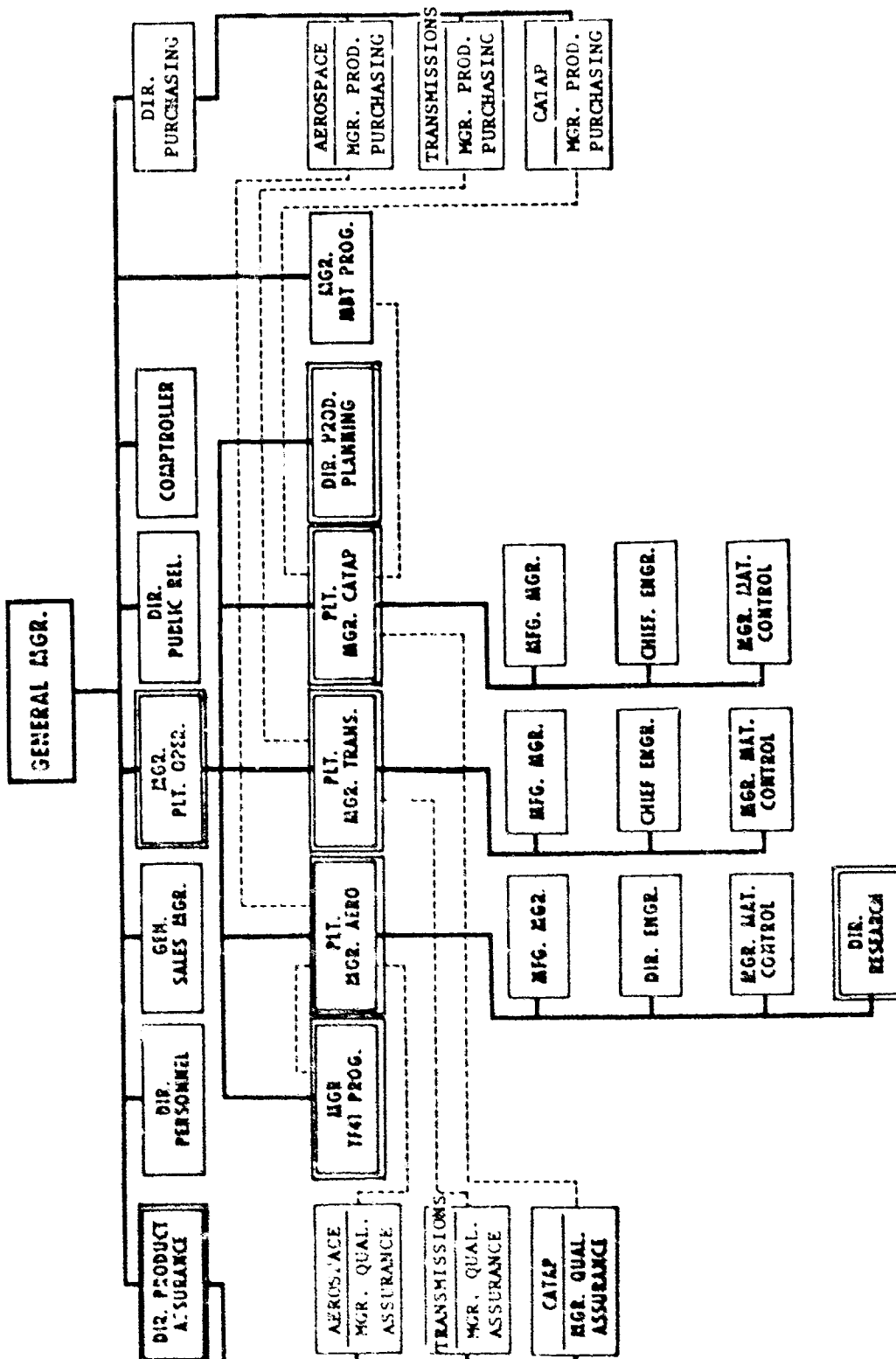
The preparation of proposals and contract negotiations with the Defense Department is by nature specific to the business at Allison, and such work falls completely under our responsibility. The only exception here is that if new contract clauses are issued by the Defense Department, these must be checked out by the Central Office Legal Staff, since, as already stated, the divisions have no legal staff of their own.

I had previously mentioned that all matters affecting people above a certain management level required Central Office approval. On the other hand, all salaried personnel below this level are handled by the General Manager at the division level; and this, of course, represents the bulk of the salaried people. All matters pertaining to hourly-rated men and women fall under the responsibility of the division.

Sales and service policies are the responsibility of the Divisional General Manager at Allison. The division is free to plan, select, and contact customers for its products, as well as perform product service in the field and administer warranty. Selling prices of many of our products have a bearing on the Corporation's national image and, therefore, in some cases require approval at the corporation level.

The next segment of this talk will take up the matter of management policy, which concerns the detail of how to manage and administer the business in order to attain objectives, plan for product development, and, above all, produce a profit and a return on the investment.

The most important element of any effective management control should be a sound financial policy.



**Figure 3.**

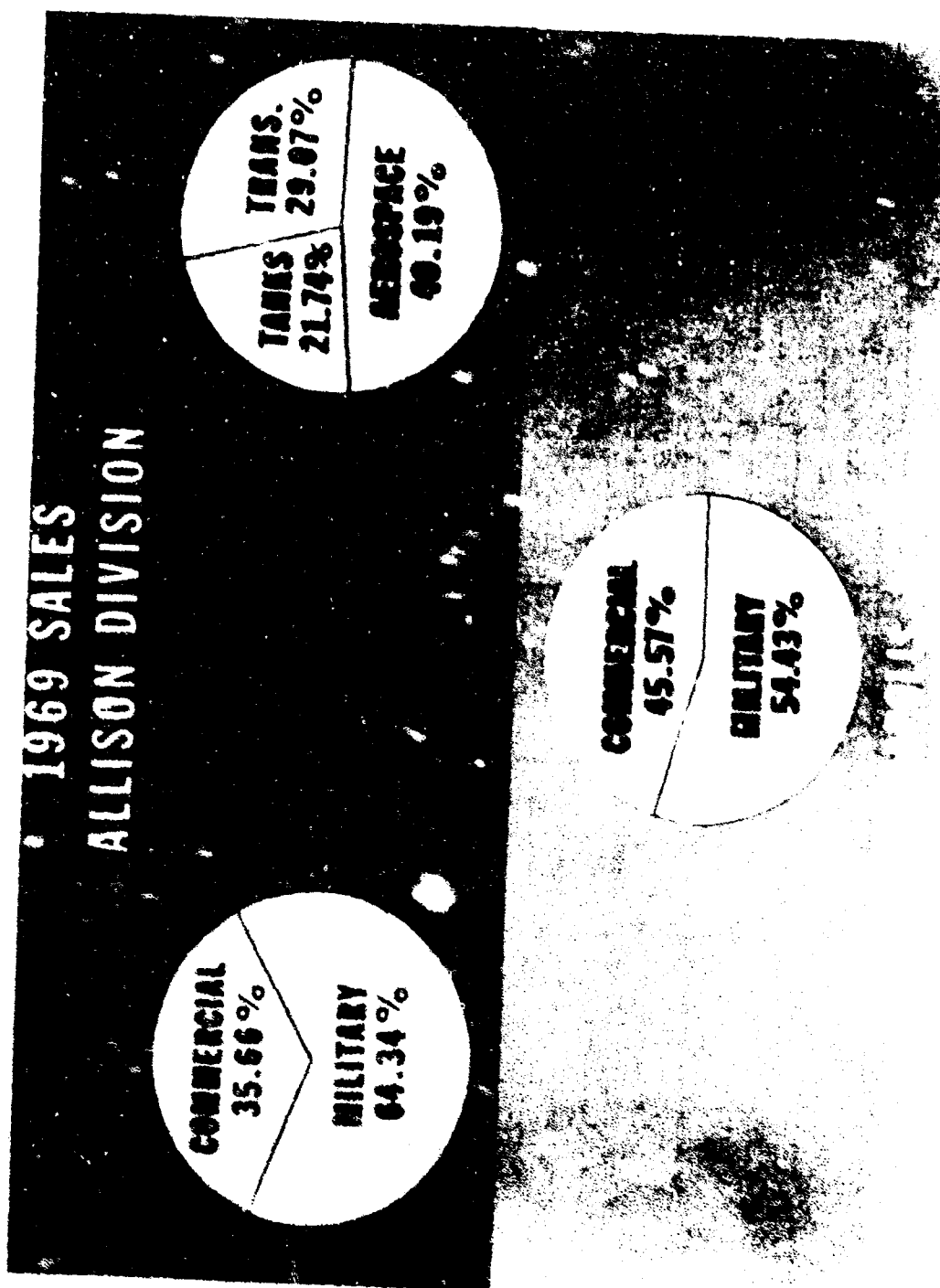


Figure 4.

This policy starts with the preparation of an annual budget which is required by the corporation and submitted by each division at the beginning of the "model year." The division budget is built up, starting with the lowest organized departmental element with all supervision taking an active part. The basis is the sales forecast for all product lines for the 12 months in the model year. A labor, burden, and material structure is then built around this sales forecast. Major expense items that must be considered are research and engineering for product support and future product growth. The cost of sales activities, including advertising, is forecast for the entire year. Capital improvements are also forecast for the year, including the expense of installation and maintenance, as well as the effect of depreciation.

The planning of the budget may not be particularly unusual except that all elements of the Allison Division budget are planned for a 12-month period, and each department head is held responsible for that entire year for his portion of the budget. The General Manager is in turn held responsible by the Corporation for the total division budget. Unexpected events that could not be, or were not, anticipated must be offset by savings elsewhere. There are always certain extenuating circumstances recognized such as an unexpected reduction in sales to the government; but the accounting procedure is such that the division can be given "credit" for this reduction and its labor and burden performance measured accordingly.

The budget is monitored in two significant ways. Each month, starting with the very first month of the model year, a 4-month budget forecast is prepared and submitted to the corporation. This

plan results in a forecast of the current month, plus the following three months. As the year moves on, the forecast will begin to include the actual expense from previous months, which when added to future forecasts is used as a prediction of ability to achieve the original budget forecast. This scheme provides twelve times at which action might be taken to alleviate adverse trends in any of the budget elements.

Another management policy to assure meeting, or beating, the budget is the insistence on individual departmental goals. A goal differs from the budget in that it is each department head's responsibility to establish his own plan for improving the efficiency of his group. In other words, he is considered as running his own little company and is expected to take steps using his own ingenuity to beat the official budget. These goals are plotted for a 12-month period and each month a report is issued to indicate progress.

Figure 5 is an example of a goal chart and, in this case, plots productive labor. The vertical scale is in thousands of dollars in savings or loss, as indicated. The short dashed line is the "goal line" and the longer dashed line represents the timed budget. The difference represents what the individual department head thinks he might do above and beyond his budget commitment. The circles plot the actual experience and, fortunately, in this case, are right on the goal line predictions.

There is a goal chart similar to this one for each of the following budget categories: total burden; controllable burden; indirect labor (nonproductive); operating supplies; expense tools; maintenance; losses, errors, and defects; and, finally, overtime premiums. The Ac-



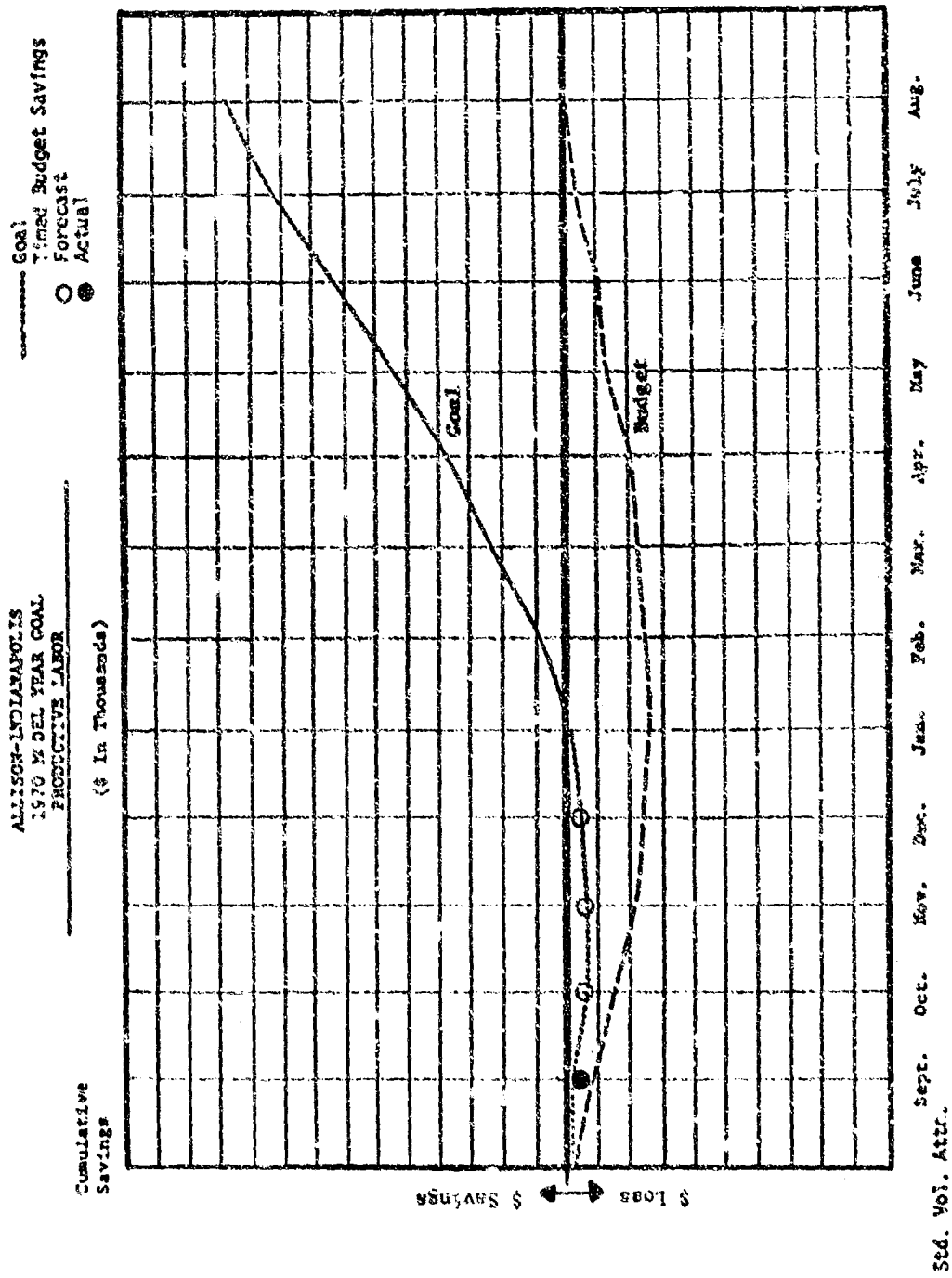


Figure 5.

counting Department provides the data for plotting the charts, but it is the responsibility of each individual department head to explain any variances and to take necessary action to attain his goal.

These budget matters are handled in regularly scheduled formal meetings each month. Top management uses this opportunity to question department heads on their progress, or lack of, and what steps are being taken for improvement. In many cases, a management decision is required, but at least once a month there is an opportunity to review progress and to make corrections.

Finally, each individual division report of performance against budget is reviewed by a Corporation Group Executive once a month. Time will not permit a discussion of the details of how the budget is administered, but it is sufficient to say that the clue is the involvement of all elements of management. It is not just a financial department responsibility. This department's responsibility is to report the progress with data submitted from all operating departments. In other words, they only keep the "score."

There are dozens of operating reports required to provide sufficient information to evaluate and correct budget problems. For instance, each product line is reported each month through a "unit cost analysis" report. Figure 6 illustrates one useful format. This breaks down a "typical" model from each product line in terms of all elements of cost — material, labor, burden, general and administrative, engineering, profit, manufacturing efficiency and standard hours.

Inventory control is vital, particularly in a complex business, because of its significant effect on return on investment. The important elements regularly reported and re-

viewed include material, labor, and burden, warehouse parts, consignments, engineering contracts and undelivered units. The important factor affecting material-labor-burden inventory is manufacturing lead time and also quality of incoming material.

Investment control is maintained on requests for purchases of land, buildings, machine tools, and inspection and test equipment. Such capital expenditures are forecast at the beginning of the year and again at the beginning of each quarter. Every request to spend money for capital improvements, regardless of value, is submitted in a formal request requiring the signature of the General Manager, and in many cases final approval by the Corporation Staff and Committees. Sufficient detail is included to confirm that recovery through sales will be in a reasonable time and that return on investment will not be adversely affected.

Cost reduction should be a management policy with any company; but the success of cost reduction programs will depend directly on the involvement of top management. At Allison everyone is expected to contribute to cost reduction, and there are several formalized programs to accomplish the objectives. There are suggestion plans in which the eligible employees are rewarded for their efforts. There are other suggestion plans where the employee may not be eligible for a monetary award, but the results are considered as evidence of his management ability and potential and records are kept accordingly. There are value engineering (cost avoidance) and value analysis (cost reduction) programs in which the engineering and manufacturing departments participate. All of these programs are pursued every day of the year.

ALLISON DIVISION  
INDIANAPOLIS OPERATIONS  
MONTHLY UNIT COST AND PROFIT REPORT

PRODUCT XTC-411 Transmission MODEL 8351763

Cost and Profit Data	Model Budget	Bid Estimate	Month Actual		
			Sept. '69	Oct. '69	Nov. '69
<u>Unit Selling Price</u>					
<u>Unit Cost</u>					
Material - Allied					
- Outside					
Freight					
Total Material & Freight					
Labor - Productive					
Burden					
Premiums - Overtime					
- Night Shift					
Cost of Living Allowance					
Employs Insurance, Taxes & Benefit Plans					
Special Tools					
Engineering					
Preproduction					
Rearrangement					
Product Service					
Other					
Factory Cost Adjustments					
General & Administrative Expense					
Total Unit Cost					
Operating Profit					
% Operating Profit to Sales					
Productive Standard Hours					
Units Produced					

Figure 6.

Next to a sound financial policy, personnel development must rank a close second. The emphasis is on the development of management, which includes shop foremen. You undoubtedly have heard the expression that the difference between success and failure of companies is the development of its management people, inasmuch as the hourly-rated labor pool is relatively the same and available to all companies. Frequently management candidates are selected from this group.

The key to personnel development is personnel appraisal and evaluation. Appraisals must be made periodically, and this is done in writing and becomes a matter of record. Appraisals are expected to reveal individual strengths as well as weaknesses. A report of weakness must be immediately followed by corrective action, and this is done by direct contact with the employee. He deserves to know at any one time how management considers his performance and his potential.

Each individual who is rated high on potential must be provided the opportunity to broaden himself by gaining experience in other related work, and in some cases permitted to continue his education. There is no better incentive than to provide management encouragement to these deserving individuals.

Many schemes can be devised to keep surveillance of outstanding individuals. One of the most simple is to maintain a priority list of those men whose current performance indicates they should be capable of accepting senior responsibility in a few years. Such a list should be revised each year to adjust for changing circumstances. However, once the list is prepared, top management has the responsi-

bility of seeing that these men are provided with the opportunity. One of the important considerations to watch is to be sure that a young aggressive man does not become stagnant either immediately behind an equally capable young man or, more importantly, a much older man who has been effective at one time but now has a declining capability.

There are financial incentive plans whereby a selected group can be rewarded at the end of a year by bonus, which is in addition to regular salary. Other employees can win several thousands dollars in awards for outstanding suggestions if they result in cost savings.

Finally, personnel planning includes constant recognition of the likelihood for promotion of the most promising people. This can best be done by maintaining a chart of such possibilities. It can recognize approaching retirement dates and expected transfers to other assignments. Naturally, such a chart must be revised immediately upon a change in circumstances or individual performance; but it is a formal guideline which makes management think of contingencies and, therefore, prepare accordingly.

Procurement policies must be carefully established and administered closely, inasmuch as for a complex industry such as Allison, at least  $\frac{1}{2}$  of the manufacturing cost is usually in the procurement of material, either finished or rough. Modern-day purchasing practices go far beyond the traditional solicitation of multiple bids with the selection of the lowest.

Quality and the delivery history of a vendor are of such importance that quite often they outweigh considerations of price. Prior to issuing a request for quotation, an estimate of its expected value must be made and then compared with the

bids. Even the low bids are subject to further negotiation.

Sound purchasing policies can benefit the vendor equally as well as the purchaser. A purchase order with well defined terms and conditions will result in a more accurate price and better quality. Both the engineering and quality control departments must work with the purchasing agent to properly draw up the terms and conditions. Detailed drawings and attached specifications, plus testing and inspection requirements, are a must. The vendor may find these rigid and difficult to meet; but he also knows that if he meets them, his product will be readily accepted and he has an excellent chance of repeat orders. A satisfied vendor is equally as important to the scheme of things as is a satisfied buyer. This latter point is often overlooked.

There is naturally considerable difference between purchasing for defense contracts and for commercial products. A proliferation of government regulations must be used and the documentation (records) maintained is much more voluminous than that required for commercial work.

A good purchasing department should have a pool of buyers, many of whom have experience in other departments of the plant such as engineering, manufacturing, quality, and accounting.

There are a number of general management policies which reflect the organization description and philosophy. I will quickly list these without much detail, inasmuch as many are self-explanatory.

The policies and procedures that have been discussed fall under the general heading of "management by objectives." The title is self-descriptive and much has been written of its benefits to business

success. We practice this principle at Allison.

Generally, an organization should be set up so that it "tends to run itself." To do this, one must avoid overlapping functions and form "natural" groupings of functions under department heads who have both authority and responsibility.

A functional or line organization is preferred, because it conserves personnel and concentrates the various skills-in-short-supply in a way that they can be most effective to all products. A program manager type of setup should only be used in very special cases, one of which would be an unusually large systems engineering program made up of several major contractors.

A minimum use of assistants, or assistant-to's, is recommended because an assistant tends to split responsibility from the department head, or on the contrary, he may find he has little responsibility, and hence very little to do. This position also tends to discourage competition for promotion among the staff.

Department heads must be chosen from experience, but possibly even more important is evidence of management responsibility. A certain amount of detailed knowledge of the product and the work can be sacrificed for demonstrated management ability and a willingness to face personnel problems.

The top management of an organization must have a communications system which invites information. Serious problems usually involve top management decisions which might have been made at an earlier date if the information had been known immediately. Top management has a responsibility to conduct themselves such that department heads and staff volunteer

important information without being asked.

A manager must communicate with his employees via his own staff. Nothing undermines a department head's morale and the respect of his employees more than to have the manager go around his staff directly to an employee with an order or a directive.

Regular staff meetings must be held at various levels of the plant, starting with the General Manager. Topics of broad interests should be discussed, and such meetings should not be problem-solving meetings. They can be problem identification meetings, but the solution should be delegated to the next level or another special meeting. A top manager must communicate freely with his staff and leave no impression that important information is being withheld or "safeguarded." Responsibility can be much more easily delegated with desired results if staff and department heads are fully apprised while operating on administrative subjects.

Operating authority and responsibility must be documented by some form of standard procedure. These would include signature authority and privileges. Although, obviously, a plant does not literally run "by the book," it is nevertheless effective to have the General Manager's policies in writing for reference and to maintain the proper discipline. (The use of the word "discipline" here refers to what can be called organization integrity.)

Technical planning for the future is discussed here last, but obviously not least. Very few product lines are self-perpetuating and any company involved in the engineering and manufacture of mechanically operating products must constantly seek new models which are more effective and offer the customer

better results for, hopefully, a lower price. Technical planning can be initiated through a formal engineering and research policy committee which meets regularly, but it is a constant process which is pursued each and every day by the development and research departments. Normally, technical planning would be confined to improvements within the general market that has already been established, but frequently a company may find it expedient to broaden into other fields. This is particularly true if there is a threat of obsolescence.

The engineering and research budget must be prepared in a detailed manner at the beginning of each model year. In some cases, a two- or three-year plan should be submitted if there is to be continuity of the project. This provides management with a longer-range appraisal of the ultimate company funds that might be required to finish a job. Furthermore, any new facilities and equipment that may be needed to accomplish the development projects should also be presented at the same time, since this will then provide the "all up" costs.

Defense development contracts are desirable, but they involve several kinds of risks, not the least of which is the lack of guarantee of continuity. Military projects frequently are initiated with a high priority, but suddenly cancelled in a relatively short time because of changing world conditions and legislative attitudes. A company heavily involved in military development work is well advised to seek substantial commercial development in order to level out the peaks and valleys associated with military contracts. Commercial programs of at least 50% of the total are desirable.

At the beginning of this talk, I mentioned that if time permitted

I would touch briefly on the difference in management policies when managing defense and commercial companies. Time has run out, and I think it is sufficient to say that there is no reason why there are significant differences in the basic principles used to manage and operate the company. The fundamentals of sound financial and personnel policies that have been outlined should be equally beneficial to defense contracts. The engineering organization and its policies would differ only in that the products must be designed to military specifications, many of which have peculiar requirements because of the worldwide use of the product.

The biggest differences would occur in procurement and financial administration, which add costs to produce products under a defense contract compared to commercial. This is caused by the Congressional requirements for control over contractors when public funds are involved. In many cases, these regulations contribute nothing to quality or product performance and certainly not to lower cost, but it has been determined that there must be "safeguards."

From a sales and service viewpoint, there are usually no negoti-

ated warranties with defense products, and service representatives are normally placed on contract. There is a need for a complex contract administration organization, many of whom must have legal experience. Such an organization is not needed for commercial products. There are many other more minor practices which increase costs, such as a security system and document control, proposal expense, briefing trips, and a proliferation of reports and a long period of time to obtain engineering change approvals. In closing, though, I would repeat that the fundamental principles of operating the organization need not be different.

I hope that this broad-brush coverage of complex organization policies can be reflected in some way in the current assignments of the officers attending this session. It was not necessarily prepared so that you might obtain direct benefit, and, of course, the necessary lack of detail on certain functions undoubtedly has left many questions unanswered. I would welcome questions, and close in saying it has been a real pleasure to meet and talk with you gentlemen on this very important subject.

**SECTION V**  
**OPERATIONS RESEARCH**  
**SYSTEMS ANALYSIS**



# SYSTEMS ANALYSIS IN MANAGEMENT

MR. DWIGHT A. INK,  
ASSISTANT DIRECTOR,  
EXECUTIVE OFFICE OF THE PRESIDENT,  
BUREAU OF THE BUDGET

**B**efore beginning my comments, I might mention that, during World War II, I spent quite a bit of time at an installation called Fort Belvoir. As a matter of fact, I spent so much time in training there that I never did get overseas to contribute much to the war effort.

To come back to the present, in the Executive Office of the President of the Bureau of the Budget, we are in the process of developing a new management program. This is a fast-moving area. We are learning a lot of things, and we are likewise "unlearning" a lot of things we thought we had learned.

First of all, I can say there is a different emphasis on management under this administration. Since this is the fourth administration I have served under, I do have some basis for comparison.

One view, to which I strongly hold, is that Federal employees, both in and out of uniform, are competent: they can and do respond when they are given the proper leadership and are not hobbled by procedural restraints. Those are two very important considerations, because in organizations as large as the services or the domestic departments, it is extremely difficult to provide leadership down through the organization that continues to bear a close resemblance, when it reaches the lower echelons, to the leadership provided at the

level of the President or even the cabinet.

Thus, within the Federal Government, which is so large and complex, we start out with a problem that is present also in some of the larger corporations. Nowhere, with the possible exception of the Soviet Union and China, is it so severe as in this country. I mention the Soviet Union, which I visited for several weeks about three years ago and saw much evidence of problems of size and diversity. It seems that in the Soviet Union, they tend not to have too much confidence in each other or in the various rival components of their own bureaucracy. Thus, the problem is more serious there, in many ways, than it is here.

The problem of projecting presidential or cabinet views down through the organization is extremely difficult, but we make it much more difficult for ourselves in that we have such complex systems and procedures. Of course, this is not because we want this situation; it is a function, really, of our very size, our very complexity. We have not been able to invent systems that are simple and can still be made to deal with large resources or large numbers of people. Consequently, it is difficult to exercise initiative, it is difficult to carry out effective leadership, at almost any level, because of the tortuous systems and procedures that we have developed.

In some areas, in my judgment, the processes we are using today in

the Federal Government are downright archaic. And I include therein the Federal budget, which I think is one of the most archaic systems we have. I think, likewise, that many of our personnel systems are outdated. But if I were to be asked how to improve them, how to streamline them, then, of course, I would proceed with some caution, because here the problems are far easier to flag than are the solutions.

I have used these examples of the personnel and budget areas because they are familiar areas. They are easy to cite in stressing that today we have systems that are much too detailed, much too complex; that we have not been able to invent streamlined operations or systems that will serve organizations as large as those of the Federal Government.

Now, the present administration is more concerned than those of

prior years in trying to do something about this kind of problem. I think this is, in part, because we have a president who is interested in results. Further, I suspect that, more than anything else, it is the mood of the country, and of the time in which we find ourselves, that there should be concern about better management. Really, there is more recognition outside of government about the complexities of the government. Although this may be hard to believe, in view of the current criticisms of Vietnam, there is, by and large, a somewhat more sympathetic view, I think, toward the problems we are dealing with in the Federal Government.

Certainly, in industry, among those men who have gone back and forth between industry and government, there is a better understanding of what confronts us. I think now is an opportune time for mak-



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He entered the Federal Service in 1950 with the Bureau of Reclamation. He later joined the Atomic Energy Commission and served as its Assistant General Manager from 1959 to 1966.

Mr. Ink has served as Assistant Secretary for Administration of the Department of Housing and Urban Development. He also chaired a Presidential Inter-Agency Task Force which recommended ways of decreasing the processing time of some Federal grant-in-aid programs.

(This article was adapted from Mr. Ink's presentation before the Operations Research Systems Analysis Executive Course at USAMS on 7 July 1969.)

ing some inroads on the inefficiencies that exist, for moving forward with the development of better systems analysis and operations research that can lead to better ways of handling some of our problems.

Recently, the President moved in an area in which presidents have tried to move for several decades, but without success. This doesn't happen to be the military area, but I will mention it nevertheless. We have had a great deal of difficulty in the domestic programs that deal with the states and communities due to the fragmentation of the Federal aid programs. This fragmentation has been a serious handicap to the state officials who have to deal with hundreds of programs designed to assist state and local governments. Each comes equipped with its own set of procedures, each has its own Congressional and legislative power base, so that the mayor, city manager, or governor finds himself in great difficulty in trying to relate programs to each other. When he does try to relate them, he has to go to four or more different cities in order to meet the Federal representatives concerned with these closely related programs. Each agency, it seems, has a different location for its regional office.

Thus, today in Salt Lake City, Utah, for example, when the city officials tried to put together a simple neighborhood service program, they had to go to San Francisco for the housing or urban renewal part of the program, they had to go to Kansas City for the health components of the program, they had to go to various other cities for other pieces of it. They were having to go half way across the country, when they could find the expense money to make the trip. Even after having gone to San Francisco and Kansas City, they still were not able to coordi-

nate with the Federal Government. As has happened many times, they finally gave up in frustration.

For several decades, presidents have talked about pulling these together, but the political opposition has been too great. We discussed this with President Johnson shortly before he left office and we thought this was going to take place. But it didn't quite. Last spring, however, President Nixon did issue an order directing that HEW, Labor, OEO, and Small Business Administration bring all their regional boundaries together over the nation and put their field offices in the same location. I don't think this is because the President had any new idea, different from those his predecessors may have had; I think the time had come when it was politically possible. There is enough concern on the Hill, among the governors, among the mayors, about the inefficiency of the fragmented geography to make it possible to move.

By and large, I believe that we have better opportunity now than we have had for many, many years for making progress in the field of management in the Federal Government. Of course, the business of systems is not new. In the days of Rome, a great deal of effort and concentration was placed on systems -- transportation systems, communications systems, government systems. It was all very, very complex, and, remembering that there was no telephone or radio, it is amazing that they were able to hold together a tremendous territory for several centuries. Fairly sophisticated systems for that day and age were required to make it possible; and, of course, going back somewhat earlier, Alexander the Great had made a great deal of progress in this respect. And you can find antecedents going back

as far as recorded history. However, in reality, not until the twentieth century, particularly not until the last 20 years, has there been a heyday in the development of highly sophisticated systems. Modern systems analysis, for which industry paved the way, is an outstanding example.

I suspect that it was our ability to propel destructive forces at great speed over large distances that ushered in a whole new era of systems development. When one thinks of the Polaris, for example, one thinks of the interrelationship of the components, particularly the warhead-missile relationship.

In recent years, then, it has been systems analysis that has really provided the framework for finding ways to manage highly complex activities. This, of course, has been absolutely necessary, because any one individual sees only a part of the whole. And, with only a part of the whole, he is unable to tie the whole together.

Let me again use as an example something from the urban field. Urban renewal projects are fairly common, and many have seen the types of problems that can grow out of a lack of a systems approach. Now, a large part of the urban renewal program is land acquisition: you have to obtain land, you have to clear it, you have to turn it over to new uses. The idea, of course, is to get rid of the slums and some marginal businesses and developments and to bring in better housing, better commercial opportunities, eliminating the blight on the one hand and developing property which has an investment return on the other. Thus, more taxes are paid, more money is put into the private sector, and, in the end, more money is gotten into the tax route than was there before the land acquisition and construction.

But what has happened in many instances is that the land acquisition people begin buying up parcels of land in an area, after which the people who moved into another area begin to develop a new slum area. Thus, one slum is gotten rid of in one place, while a new slum is created in another. Then, often, after the land is cleared, it remains idle and vacant for periods of six to eight years, because the later phases of the program have not been worked out. It does not contribute to the tax base and cannot be used for housing; it is disruptive of communities, school districts, and transportation systems. Thus, through failing to link together the land acquisition component with the housing component, the relocation component, and the commercial development component, programs that are launched, cannot be completed, or, over a long drawn-out process, many people suffer both dollarwise and through loss of homes.

Thus, the lack of a good systems approach, or good systems analysis, is something we find confronting us often, even in the case of pretty common types of activities, and not just in the case of some of the sophisticated weapon systems. We should already have learned a good systems approach, because of its applicability to the common garden types of problems that we have had to cope with for many, many years. But we really haven't learned much through these; instead, we have had to learn through advanced technology, through such things as the Polaris system. And, of course, because the individual components are often in conflict with each other, we have sometimes experienced great difficulty in making progress.

In the case of the Polaris, as is known, the warhead people wanted a large missile; they wanted a big-

ger submarine to launch a bigger missile. The missile people, on the other hand, wanted a smaller warhead. The submarine people wanted a smaller missile and smaller warhead. All this had to be balanced out.

In several fundamental aspects, the character of our space program goes back to this very kind of problem. Because we were more successful than the Soviet Union in the initial days in developing small warheads, our atomic capability greatly outpaced that of the Soviet Union. We were able to get a bigger bang from a smaller warhead. Consequently the Soviet Union had to develop bigger missiles in order to have the same destructive power that we had. Then, when the space program came along, for entirely unrelated reasons, the Soviet Union had been developing larger launch vehicles. After our success with the warhead, we suddenly found ourselves behind in our ability to launch the kinds of vehicles that were necessary for manned space flight. We had a lot of catching up to do.

I think it is obvious, then, that there is a great need for systems analysis. And in this respect, I think I would tend to agree with those who maintain that operations research is really a means, a tool, for carrying out systems analysis.

The need for systems analysis, as I say, is obvious, just as are some of the pitfalls. One of the pitfalls can be found in that systems analysis too often tends to ignore the fundamentals as, likewise too often, it tends to get into the hypothetical, working from a weak base.

As a primary thing, it is important to pin down the facts, one by one, step by step. Don't let your people assume things, and when studies come to you for your review, I think this is one of the

first things to check out. Have all the facts been pinned down?

I remember several years ago there was a plan to provide a nuclear capability, utilizing surface-type ships. We would use some kind of surface ship configuration to avoid revealing the secret of the design of our nuclear submarines even though we would have our ships manned by other NATO nationals. The Americans would retain an effective veto over any expenditure of the warheads, but the others would feel a sense of participation in the nuclear capability.

Many assumptions were made which appeared sound, and the basic premise was fairly simple. But it wasn't until we got down to the cradle-to-grave sequence of steps that we were really able to see what the technical problems were. For instance, there were the problems of access and ingress for different types of maintenance. What was to be done when there were visits to be made by the dignitaries of the foreign countries? There were all kinds of practical problems that had to be examined, step by step, before we could really begin to understand what was involved, before we could really begin to size up the problem. The whole affair, however, had gotten off to a bad start because of the attempt to sell it before it had been thoroughly thought through.

Don't allow the systems people to make the system too elaborate. While it is important to pin down all the essential steps, in designing the system or in recommending changes in a system, it is equally important that the system be designed for the resources that are available. I have seen many instances where the contractor who was given a contract to come up with a new system — whether accounting system or procurement

system — looked only at the parameters that dealt with the quality of the system, whereas few or none of them may have dealt with the cost of operating the system, the number of people required to operate it, and so forth.

There is sometimes a tendency to develop a highly intricate and sophisticated superstructure that is really built on a foundation of sand. There have been various types of cost-incentive contracts that were developed for use when the basic cost elements themselves were not present. In such a case, we are really not going to know whether or not there were any cost savings. Perhaps the contract lent itself to this sort of thing. When there is no real surveillance of a contract, it is let, the contractor starts about his work, and there is no one to very carefully administer the contract. We must have an intricate system for contract administration. We must be able to administer such a program; we must have the capability to handle a sophisticated system.

This again reminds me of the time I was in training at Fort Belvoir. We were doing some road work at A.T. Hill, which is not far from Fort Belvoir. We were all trying to learn to build roads and each of us had a section of road to build. My section, as I recall, was in a particularly difficult area. It was hilly, with a stream going through. I worked long and hard on the curvature of the road and getting the incline right. I thought I had done a pretty good job, but the master sergeant, who was in charge and had had a lot of road-building experience, thought differently. He made it clear to me that I had managed to curve the roads properly, to incline them properly, to get the drainage just

right, but I had ended up going in the wrong direction.

Applying this to systems, we find a fundamental problem. Very often, right at the start, the wrong assumption is made by somebody. And, once you get a wrong assumption built into the base, you can never retrieve it, no matter how much you analyze, no matter how much effort you put into its design.

I think it is also very important to make sure that the analytical work is understandable. Don't be shy if you don't understand some of the terminology or some of the material; don't assume that, merely because you are not an expert, it will be nonetheless understood by others. The chances are that your superior officer, for example, won't understand it as well as you do. Chances are that he is less close to the specifics than you are and has less time than you to try to figure out what the terms really mean.

It is very easy in any field to develop a jargon that only the professional can understand, and, left to its own devices, any profession will use more and more of that jargon. We are in danger of this happening in the field of management. Make sure that the terminology is easily understood. Make sure that the material is related to something with which the decision-maker is already familiar. This is a deficiency in much of the material forwarded to the Departmental and White House decision levels. Material comes in from all sorts of different sources, and, to great extent, it is related to what the writer himself is familiar with rather than being related to that with which the Secretary or the President is familiar.

Assumptions must be sound. It would seem to be something that is self-evident, but it is a principle which is breached time and time

again. Unfortunately, of course, what is a sound assumption to one individual may not be a sound assumption to another. And a sound assumption is not always susceptible to a clear definition.

Another important factor is independence. Fresh, independent viewpoints are important, but let's make sure they are not accepted to the exclusion of experience. Experience has to be factored into the study. We have to draw upon the background and expertise of people who have been through these kinds of problems and who have practical experience. The whiz kid concept, of course, has been heavily maligned on this score. I happen to think that, at least in the early days, there was a good deal of validity to this criticism. I have seen studies come out of the Pentagon in which there obviously was simply the desire to make use of independent thinking, fresh thinking; completely overlooked was the importance of also drawing upon the background of the admiral or captain who had been out in the ships.

One study that I encountered is a good example of this kind of problem; it was a cost effectiveness study on a nuclear aircraft carrier. This study, it seems, did much to discredit cost effectiveness and systems analysis on the Hill. This study was not for the purpose of deciding whether there should or should not be aircraft carriers built, but whether they should be nuclear or not. As I recall, there was no credit given the nuclear mode because of lack of corrosion coming from the stack gas coming from the carrier. Apparently, the people who made the study did not realize that you have a maintenance problem on an aircraft carrier growing out of the effect of stack gases. Had they drawn into the study someone with

aircraft carrier operating experience, I think this problem would have been taken into account.

In another case, freedom from supply ships was analyzed against World War II conditions. In World War II, of course, this wasn't really much of a problem, because we had control of the air and the supply ships were wherever the aircraft carriers needed them.

I don't know what the results would have been, had the study been done on a more thorough basis. It might well have still concluded that we should go conventional rather than nuclear. My point is not that it came out with the wrong decision; I'm not really enough of an expert to know which way it should have come out although I have strong views of my own. But what I do know is that, because there were enough basic flaws in the study, the result was not only that the study itself was discredited but the whole analytical approach tended to be discredited.

It is vital that we pre-test systems, not just their components but their interactions as well. And, of course, it is self-evident that we pyramid the uncertainties, the unreliabilities, as we move forward over the range of components. But, because of budget and time constraints, it is very, very difficult sometimes to test the full system, and in a real life condition. It is also important to test the system, using the kinds of people who are going to be operating it. That is another problem. Often, the system is tested in laboratory-type conditions; then things go wrong when it is handed over to the users, who are not familiar with such conditions.

And, naturally, all our systems analyses, all our operations research, is sheer waste unless there is good execution. I happen to be-

lieve in the approach that stresses fundamentals. The execution is vital: it is important to check things out in operation, it is important to see whether they operate in the way they were designed to operate; it is important to have people who took part in the design participate in the check-out.

I remember visiting, some years ago, a number of our NATO bases along with other Defense Department personnel. We were always surprised to find how different things were in operation, compared with their original design. At times these differences make all the difference in the world; sometimes it is the difference between a system becoming operational and not being operational.

Now, whether it be a question of systems analysis, or any other field for that matter, personnel management can be the single most important element of management. We simply are not spending enough time as managers in handling our people, in getting the most out of our people. In this connection, one of the things that always impressed me about Admiral Rickover is the large amount of time he spends on the careful selection and training of the personnel under him.

Systems analysis is not a substitute for strong management. Some people think it is, and some people act as though it is. I believe that modern management underestimates the impact of the top man in any organization, whether it be a section, a service, a department. I think the potential imprint of the individual on his organization is great. Too often, I think, we tend to build systems as a substitute for strong leadership and strong management. Very often, likewise, the systems we build tend to make it more difficult for a strong and capable individual to

carry out his assignment effectively. It is difficult, of course, to know how to balance things out; it is difficult to sustain the checks and balances which are needed along with the freedom to move ahead, which a strong manager requires.

I am confident that, over the next several years, we will see a greater emphasis on management per se, rather than on the trappings or packaging of management. A lot of this will be low key; some of it will have less publicity associated with it. I don't think that we will see a trend toward more people in management. Many of our systems are so archaic that, until we can get better, more efficient systems, there is no easy way of cutting down on the number of people.

I used to notice that, whenever a system was to be developed, often a firm would be given all the parameters, all the base lines, all the things that dealt with improvement. But none of these dealt with the required number of people to operate the system, or its costliness, or its complexity. We have to turn that around and make sure that the system we want will be within our capability to operate.

I think that the mood of the country is such that we have the opportunity to move ahead. It is also clear that the criticism of the proportion of resources going to defense today is a problem. I think that some of the critics tend to forget that, without a strong defense, we probably wouldn't have anything of real value left to defend in this country. I think it is quite important that we eliminate our vulnerability to charges of inefficient management. I think it is important to improve our procurement system, for example, because inefficiency can serve as a lightning rod for those who don't recognize the true value of defense.



In the defense area, particularly, I believe we have every incentive to do a careful, thorough job of revamping, remodeling, and streamlining our management systems to the greatest extent possible.

### NOTES

## FOR BETTER USE OF PRESENT OR/SA TALENT

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**I**n this position, I have frequent opportunities to summarize my views and impressions for my bosses, most of whom are presidential appointees. Recently there has been a large turnover in those jobs. I expect to have another opportunity shortly to present my views, but I thought that first I would present them in this article.

I would like to begin this discussion by calling attention to the Army's heritage in systems analysis. I think it is important to remember that the Army did in fact pioneer in the field of operations research and systems analysis.

Years ago, the Army organization included the technical services, which, by their very nature, were committed to support and use research. Operations research was certainly not left out of consideration. A cursory review of the Army's operations research history since 1946 will reveal that the Army pioneered many methods whose inputs required a good system of analysis. Also, it should be pointed out that Army operations research has been, and continues to be, characterized by certain aspects which make it both unique and enviable. Its uniqueness can be traced to the fact that for years the Army has been very close to the systems it has been called upon to study.

For years, the Army has been in the business of generating the initiative required for a full understanding of its systems. As developer of the inputs and nursemaid of the equipment, the Army has lived with the problem. I refer to the capability which the Army has developed over the years as a "complete" capability. It is complete in the sense that it is based on the development and understanding of the various inputs which are required. It is complete in the sense that it is able to use that understanding of input to develop more meaningful models and other analytical tools. I cannot stress enough that the ability to obtain and develop the basic inputs required for these studies and to carry out the experiments suggested by our analyses represents an asset of untold worth.

If some cannot understand how valuable that asset is, perhaps they should consider that many of our contractors must first come to us for data and general guidance before they can even begin to help us with our problems. The ability to work with input data — to develop it, to use it by incorporating it in models — is undoubtedly of great worth. I think we should all remember this in our work. We should all be proud of the work which the Army has done in the

field of operations research and systems analysis and not forget the advantage of the "complete" capability that I previously mentioned.

Now, having recognized that we have attained that capability, we must also realize that this capability carries with it the responsibility to also maintain it. We must not allow this responsibility to dissipate. And when poor or missing data are surfaced in analyses, we must assure that adequate experiments are instituted to fill the gaps. Only in this way will we be able to help preserve that unique capability and be able to continue to support the many organizations that come to us for help. By any measure, we have inherited a solid foundation in operations research/systems analysis, and we must meet the responsibility of using that foundation for further progress.

I would now like to touch very briefly on the need to employ the systems approach. This is really not a new point, but there is considerable evidence that more thought must be given to the application of the systems approach. Considering equipment, for example, we must continue to ask such questions as, What does this weapon or this piece of equipment contribute to the effectiveness of the entire system? We can no longer assume that all that is necessary is to improve specific items or parts of a system and let someone else make the necessary adjustments in the related organization. Expected changes must be related to a change in the output of the organization or system as a whole.

A great deal has been said about cost and effectiveness analyses. In my judgment, there is a great need



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to strike a better balance between cost and effectiveness in the analyses being carried out today. Whereas, originally in the Army, effectiveness received the primary emphasis, I have detected a significant increase in the emphasis now given to the cost side of Army analyses, and that is how it should be. I am concerned, however, that the pendulum may have swung too far. Today we find considerable discussion and great concern about cost analysis; but relatively little about effectiveness analysis in our studies.

And in the area of cost analysis, I would like to warn against the all too common interpretation that cost entails merely a more accurate prediction of the price tag. There is a big difference between cost and price. Actually, I prefer to use the more cumbersome term "resource expenditures" to emphasize the more fundamental and choice-provoking sense of cost as it is understood today.

An indication of the growing appreciation of both the significance and complexity of the cost side of analysis can be seen in the use of such terms as "lifetime cost" and "cost modeling." To work effectively in this area, we must bring together those who develop the price tag and those who are familiar with developing cost models which relate accurately to the effectiveness of the systems. Only in this way can effective cost modeling be conducted. Today, cost modeling is too often left in the hands of pricing experts who often botch the job because of a fundamental lack of appreciation of the total system and its effect. In order to be realistic, cost modeling presupposes a strong appreciation of the total system and its effectiveness.

Now for a look at the use of available operations research talent within the Army and the importance of training new analysts. As indicated earlier, I know that we have a good cadre of experienced analysts within the Army. However, that group must be continually supplemented by new analysts with the appropriate training to carry on the Army's work. We must remember that during the past six or seven years systems analysis has become extremely popular in all sectors of our economy and this increase in popularity has created a correspondingly greater demand for professional operations research analysts. This demand is way out of balance with the available supply of professionals, and an imbalance exists in almost every component of the Defense establishment.

A problem for the Army, as well as for the other services, is how to best use the available resources, at the same time training the additional personnel that are required. The natural tendency, in the light of this tremendous surge of popularity, is to establish many small operations research groups throughout the Army establishment. This appears to be the tendency everywhere. Personally, I believe this is wrong, in fact, self-defeating. The establishment of numerous small groups can result in staffing problems not only because good talent is not available to fill the approved slots, but simply because the slots and the organization exist.

I was struck by an inconsistency between the content of the Army Management School's Operations Research/Systems Analysis Executive Course and the prerequisites for admission to the course. Among the prerequisites, I find that both

military and civilians must be assigned, or under orders, to an OR/SA position. Yet in a description of the course material I note that participants will be taught some elementary ADP, given a review of algebra, statistics, probability theory; given a smattering of regression analysis and even of differential calculus and some elementary game theory.

I think this speaks to the very point I was making about professional supply and demand. It is not clear to me why people who evidently do not understand some of the elementary principles are being assigned to OR/SA positions. Could it be that this is our way of coping with the imbalance I mentioned? It seems to me that, because of the shortage of qualified personnel with the fundamental background required to do the job, we are forced to take good people who have demonstrated their ability to manage, put them into the slots, and then give them the necessary background required to do the job, hoping that their managerial talent will sustain them until they can accumulate some of the needed technical background. Somehow, I would have thought that the non-OR/SA executive would benefit most from such a course. But, in view of the supply and demand, this is probably the only solution.

Let us take the other elements of the DOD; let us take the Office of the Secretary of Defense, for example. In OSD, it appears to me that they pay no premium for experience. The Army takes experienced people who have demonstrated managerial capability and tries to guide them in this very specialized discipline. But in OSD they take bright, young, well educated people with no experience and make them essentially generals. In the Army, of course, you don't be-

come a general until you've been in the service for at least 20 to 25 years. It is a system based on experience. I know there are many who don't think this is fair, but the system has a lot of merit.

Now, recognizing that we have this imbalance and that there are good courses to fill the gap for people who have good managerial talent, I think there are some other things that we could do to help stamp out the imbalance. I think that at the present time we need a certain measure of centralization. I think we need to reduce the number of OR/SA organizations while at the same time bringing as much of our available talent together into these organizations as is possible. Then, when additional trained personnel become available, we should expand the kinds of organizations we would like to have. I think we must do so until we begin to develop the necessary talent to staff the additional offices which good organizations indicate are necessary.

Now, in our own office we have seen repeated instances where organizations with limited resources have concentrated those resources and managed to produce some good studies. It was only when these organizations attempted to disperse their studies among many small groups, each having limited talent, that we began to get a spate of studies that invariably required re-doing.

In bringing up centralization, I know I may be hitting at some of the vital parts of empires. However, I am convinced that, through some form of centralization, we will concentrate our best talent on important issues, we will maintain a higher level of objectivity, and we will take a major step toward solving the related problem of training new analysts.

As for training new analysts, I submit that this effort must be undertaken by seasoned professionals. It takes much more than several degrees in mathematics, physics, or even operations research to make a good analyst. Experience has shown that, regardless of academic background and attainment, there is still only a 50% probability that an individual will become an effective analyst. But even among the 50% who do become effective analysts, a fairly long apprenticeship doing operations research studies is necessary.

The Army, it seems, is filled with managers and reviewers who have never been doers. Centralization of current talent will give us organizations which, on the other hand, will manage and conduct large segments of our operations research efforts and, on the other, function as places where newcomers to the field can learn the trade.

In your positions as OR/SA executives, you will often be responsible for the future training of new people. When you are given this responsibility, seek out the professionals. Make sure that the newcomers to the field get an opportunity to work closely with those professionals. If possible, see if you can get them to do so for a few years.

I should stress that, as OR/SA executives, you should always remember to find the professionals. Learn to recognize who they are. You will find that there are quite a few of them in the Army. While it may take some time to learn who they are, it will more than pay off to seek their advice and ask them to check your efforts. Knowing whom to consult with is of great value.

Before I leave the question of training, I would like to mention training in the military. Those mil-

itary who are in such a position as to seek training for themselves should make sure that, in addition to any academic training, they are able to get themselves assigned to organizations which are in the business of doing analyses on a full-time basis. It is a little easier for the military to accomplish this than it is for civilians. Do not assume that an academic degree is enough.

Now, as OR/SA executives, you will do analyses, but, at the same time, you will also be questioning and, incidentally, rocking the boat. If you do not question or do not rock the boat, you will not be doing your job. And you have to remember that every other OR/SA organization in and out of DOD will be doing exactly the same thing. They will be questioning and challenging your work. They will set patterns and set positions and sometimes rock the establishment.

In your own organization you are going to have to establish positions, and, while people don't like to talk about it, you are then going to have to sell those positions. Now, selling is not a dirty word; however, selling can be done poorly. As people who are going to have to sell their positions, it will be especially valuable to become acquainted with and know the people at all echelons of the OR/SA business. Now, some may be inhibited by the echelon structure we have: you have to go to your boss first; he permits you to go to the next echelon, where you must get permission to go to the next; and so on. In your scientific discipline everybody gains from discussions, from maintaining the dialogue. I think that if you are persistent enough and show enough interest, you will be permitted to speak to the people at all echelons.

In our office, we get calls from people from AMC, CDC, and other

organizations. If they come into the building, we like to sit down and talk with them and hear about their problems. I think you should avail yourselves of these advantages. You need to understand the needs of the higher echelons, and you are only going to be able to do that by maintaining a dialogue. Moreover, it will help them understand your position if you get an opportunity to talk with them. More important, I think you will begin to put across the idea that you are at the levels where the operations are going on, that you are familiar with details of your work that the higher echelons could not be aware of. By maintaining a dialogue, by visiting their offices occasionally, you will make them aware of aspects of the problem that they perhaps do not know about. That awareness has got to be helpful; it can't hurt.

Speaking of salesmanship, I would like to caution against another trend that I have seen developing. In dealing with higher echelons, too many individuals think that all that is needed is good salesmanship. Thus, we find too much emphasis on positions that have been established too quickly and arbitrarily. There are also arbitrary back-of-envelope studies prepared to sell poorly conceived positions. These poor efforts are then presented to higher echelons with the bravado and confidence of the topmost salesmen. I can assure you that this type of sales approach has been tried before and failed in almost every instance. Don't take short cuts: do the best analysis you know how to do.

In closing, I would like to quickly summarize. Please remember that the Army has pioneered in operations research and systems analysis and that it has a unique capa-

bility that must be maintained. (I am sure this goes for the other services as well.) We must keep in mind the systems approach. We must maintain a better balance between cost and effectiveness analyses. By themselves pricing experts are not good enough for good cost modeling. We have an imbalance in supply and demand for good professional talent. We should recognize that some centralization is going to be necessary; it will give us better utilization of our talent and provide us with the organization for teaching new talent. Use the professionals: seek them out for both training and consulting purposes. Maintain contact with and keep a dialogue going with the higher echelons. Learn their needs; keep them apprised of your views and know-how. Sell, but don't try to get away with good salesmanship alone. Sell by turning out a good product.

I am aware that systems analysis in the OSD has been strongly criticized by Congress and the newspapers and that, as a result, our entire profession has received something of a bad name of late. This is unfortunate, because the failures of OSD analysts, who are the focus of most of the critical comments, should not be transferred to the rest of the profession. It is also unfortunate in another sense. The fact of the matter is that, to my view, OSD systems analysis had earned a great deal of the criticism it has been receiving. The irony is, of course, that the criticism is deserved, not because they did some systems analysis but because they did not do some systems analyses. Had some good analyses been done, I am sure they would not have received the criticisms. I am convinced, however, that, despite the fact that perhaps our image in the profession is not

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as high as it should be, when additional people come into the field and begin to do good work, the image will improve.

## **NOTES**



# HOW SYSTEMS ANALYSIS CAN HELP THE ARMY MAKE GOOD DECISIONS

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I was much honored and pleased to be asked to give a talk to the members of the OR/SA Executive Course, and accepted with alacrity, because the mechanics of decision-making in the Army and the DOD has long been a matter of deep interest and concern to me.

The description of your course states that its purpose is to provide commissioned officers and civilian members of the Army with: (1) Understanding and appreciation of operations research/systems analysis (OR/SA) techniques; (2) Capability to evaluate critically OR/SA studies; (3) Capability to interpret OR/SA studies to decision-makers; (4) Capability to manage OR/SA studies. All of this is to be done in four weeks, and in that four weeks you are also, I understand, to be given such knowledge of probability theory, statistics, and other mathematical tools of the trade as is necessary to become an OR/SA executive.

I admire the courage of the designers of the course, and still more admire the courage of you, the participant students. In four weeks you will come forth, duly labeled, stamped, and certified OR/SA executives; and, since you are so licensed, you can confidently expect that you will be tasked to comment on the value and validity of studies done by other OR/SA practitioners

as a part of the decision-making process in the Army. Having from time to time been required to try to discover why an elaborate Army study which cost many tens or hundreds of thousands of dollars came to a conclusion that just plain felt wrong, or to discover the hidden flaw in an analysis performed by those practitioners of the art who inhabit the office of the Assistant Secretary of Defense (SA) when they rejected the obviously correct conclusions of an equally elaborate Army study, I know that it is not easy to do a responsible job of critical review of a well-organized study. And that is what you are to learn in the next four weeks.

What the game is all about is to help the Army, and the DOD, arrive at good decisions. The scale is awe-inspiring, when we contemplate the fact that the introduction of a new rapid-fire gun for installation in Army combat vehicles implies an ultimate expenditure of some \$2 billion of the taxpayers' money. This decision doesn't appear to be very important, compared to the decision to buy the Cheyenne helicopter or to deploy the Safeguard system. But the cost of Safeguard is only about \$6 billion. The Army is evidently so big that even little decisions become big ones, measured in terms of the commitment of human lives and effort required to

carry them out. So, then, the name of the game is to try, so far as is humanly possible, to assure ourselves that our decisions are good ones, that we neither waste resources in buying large quantities of things that are not enough better than the things we now have to justify the change, nor fail to provide generously the things that may really make a big difference in the ability of our soldiers to live and fight effectively on the battlefield.

As I contemplate the decision-making process as it faces those of us in the R&D business, it seems clear that there are several clearly distinguishable kinds of decisions. In the latter half of the 20th century, the task of the R&D man-

ager no longer just to push to create an environment in which discoveries useful to the military can be made. The pace of technological evolution has accelerated to the point that the task is now one of choosing between a multiplicity of attractive alternatives, all apparently feasible, all evidently capable of adding to the efficiency of our forces, all potentially capable of absorbing enormous amounts of human endeavor just to carry their development far enough so that the potential user can see the system in hardware and form an opinion as to its ultimate utility. And, in this selection process, which amounts to deciding to foreclose options by deciding not to develop



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In the period 1942-46, Mr. Poor served as a Naval officer with assignments in aeronautical R&D. He joined the staff of the Army's Ballistic Research Labs in 1948, and in 1949 became Chief of the Future Weapons Systems Agency.

Since 1960 he has served in the Army Secretariat, as Special Assistant to the Assistant Secretary (R&D), as Deputy Assistant Secretary (R&D), and, for several extended periods, as the Acting Assistant Secretary (R&D). He has served as a member of many government advisory committees, including at present, the NASA Research and Technology Committee on Aeronautics; Panel A of the DOD Industry Advisory Council; Defense Science Board Task Force on R&D Management; and the Army Civilian Executive Personnel Board.

(This article was adapted from Mr. Poor's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 10 Feb. 1969.)

the hardware, we had better be right. If we're wrong, the nation can later look upon our work and wonder at our irresponsibility in failing to provide a capability which another nation has achieved.

In recent history, there have been at least a few cases where we came perilously close to making disastrously wrong technical decisions. The ICBM program is a case in point. Careful analysis of the cost and effectiveness of intercontinental rocket delivery systems, carrying warheads of the sort we knew how to build in 1950, led inescapably to the conclusion that rockets made no economic sense, that reliance on bombers was prudent, and that the Russians, who were diligently engaged in building big rocket boosters, were simply out of their collective minds.

The discovery, at nearly the same point in time here in the U. S. and in Russia, that there was a way in which one could build lightweight thermo-nuclear weapons completely changed the problem parameters. Now it was easy to see that we could make rockets whose delivery accuracy would be compatible with the radius of effectiveness of the warhead carried, and so build systems whose cost was substantially less than the value of the damage they could potentially do to an enemy. These conditions had not been met by the ICBM systems proposed before the thermo-nuclear design breakthrough. Now they were.

It is a real tribute to the much maligned military-industrial complex that the response to the new challenge resulted in the Thor and Atlas delivery systems, so quickly developed that the Russian advantage of some five years of development of big boosters did not result in a missile gap. Thus, our strategic deterrent stayed ahead of the Rus-

sian deployment, and, in fact, far outstripped it.

This story isn't a story of a bad study; it is the story of a good study of a system which was easy to analyze. The conclusion was that ICBM's made no sense when the warheads were either so heavy that the booster costs would be ridiculously high or so low in yield that the booster inaccuracy would result in virtually no effectiveness. This conclusion was absolutely correct. It also followed that if the system made no sense, it would be ridiculous to spend millions of dollars on the booster components or the guidance systems or drilling holes for launch sites.

That the story had a happy ending is, of course, an accident. When the understanding how to build lightweight multi-megaton weapons first became available, the same people who had decided to stop the ICBM project learned of the development, realized the engineering and system implications, and started the program up again.

This, then, is an example of one kind of decision you will be called upon to help with, a decision in which the technology dominates the answers. If you can make lightweight warheads, ICBM's are a sensible and necessary part of our strategic deterrent. If you can't make light warheads, then ICBM's are a technical and economic nonsense.

In this class of decision, the technology-dominated decision, we must recognize the fact that no one without adequate skill and knowledge of the technology that counts in the problem at hand has the ability or the right to make meaningful remarks about the feasibility of new systems. You, then, as you embark on your new career as decision-maker interpreters and consultants, will need to be particularly alert

to technological innovations. It seems inevitable that the real breakthroughs will be recognizable only by a few people, initially. These few will be technology-oriented people, not systems analysts, or operations researchers, or logisticians, or commanders of artillery battalions. In the next few weeks you surely cannot acquire the depth of technological understanding required to help you in forming a valid opinion as to whether or not what a scientist maintains is an important new development really is what he says it is.

There is one lesson to be drawn from this rather extreme example of a technology-dominated decision. It happened only because the people who understood the technology were in very direct communication with the people doing the system design and effectiveness analysis. Both groups, the research physicists and the systems analysis experts could talk freely to one another, and, since the mission of strategic deterrence was well defined, the system was, in a very important sense, self-organizing. A completely valid study could be done by assuring that the inputs from the engineering community were correct; and, to comment on the study, one needed to assure oneself of that fact. The rest -- the conclusion that we should build ICBM's -- followed logically from a very simple analysis.

The lesson here is to be sure the inputs are right, and that the logical structure of the study is impeccable. A major difficulty lies in the assessment of the technological input. That is not a job for economists or military experts, or sociologists, but one for engineers and physicists. The OR/SA executive job, then, is to be sure that the most competent scientists are heard from on technology-domi-

nated decisions and that they participate directly in the study, so that you can thereby assure the reasonableness of the conclusion.

The vast majority of the choices to be made, as we seek to upgrade our military forces to get more capability for each dollar we spend, are not technology-dominated decisions about self-organizing systems. While we can compute the savings in ICBM warheads required to destroy a certain number of USSR targets that would accrue were we to improve the accuracy of the ICBM guidance system, and, given reasonable estimates of the improved guidance system, reach unassailable conclusions as to the cost benefits of the proposed improvement, that is, after all, only another example of a self-organizing, technology-dominated decision.

Army decisions tend to be much more difficult. Seldom are they technology-dominated. Seldom is it even clear how the various alternatives interact, or even whether or not the alternatives have been properly listed. Most decisions are neither self-organizing nor technology-dominated. For example --

What proportion of Army effort should be spent on the acquisition of a new artillery system? Is it worthwhile to develop a multi-rail artillery rocket system which competes with aircraft and tube artillery as a means of engaging certain but not all classes of potentially important targets?

Technology says that we can build new tanks, capable of substantially greater accuracy of fire than those we now have in the inventory, capable of shooting on the move nearly as well as the current inventory tanks can while standing still, and, at still greater expense, capable of fighting at night with nearly the same effectiveness in seeing targets and identifying them

as current tanks enjoy in the daytime. The things we have learned about inertial navigators and lasers would allow us to add to these tanks a navigation system which, coupled with a laser range-finder would allow these tanks, or any other vehicle similarly equipped, to feed precise firing data to any artillery battery, so that artillery fire could be brought to bear on fleeting targets of opportunity.

It is quite clear that we can build such a super-tank; the design of the MBT-70 incorporates some of the features I have mentioned. It is also quite clear that by the time we incorporate the degrees of sophistication required to attain the high-accuracy shoot-on-the-move capability, passive night fighting and surveillance capability, and the ability to utilize anti-tank guided missiles as well as high-velocity conventional anti-tank ammunition, the cost of the vehicle will have risen to the point where the alternative of much larger numbers of simpler, cheaper, less effective tanks cannot be ignored.

Now comes the tough question. Do we want a few very effective tanks, or a lot of less effective tanks, or perhaps a mix of both sorts? If it costs, say, \$400 million to develop and test a super-tank and establish a design sufficiently reliable to use in the field, can we justify the development on the basis of the greater military effectiveness per man on the battlefield that possession of this super-tank would confer on our forces? Will not the advent of cheap infantry guided missiles like TOW, which can kill any known tank from ranges up to 3 km, simply sweep all tanks from the battlefield in the next decade?

The Army has approached questions of this sort with courage and determination. One of the things I

think you will learn in the next four weeks is how very good the Army study system is becoming. We have learned that one cannot study Army weapon systems in isolation, that any adequate study must take into account the changes in doctrine, organization, and employment of other portions of the Army force structure and weapons inventory required fully to exploit the properties of a new weapon system.

Dr. Payne, who has spent most of his professional life doing weapons systems analysis, and has recently been in a singularly well placed position to assess our Army studies in comparison to those carried out by other Services and by the Department of Defense, told a prior class of CR SA executives that the Army studies are now second to none in quality, completeness and validity.

The reason the Army studies are as good as they now are, is, I believe, that we have come to recognize the importance of bringing together in the conduct of any study, expert people, competent in all of the fields of human endeavor pertinent to the evaluation of a new weapon system. The Army is itself a weapon system of enormous complexity. So, to assess the impact of change in the equipment of the Army it is essential that the study group be able to discuss, quantitatively if possible, the changes implied throughout the Army structure.

The technical questions of cost and effectiveness of a given system design need accurate definition. The military commander's imagination must be brought to bear on how best to use the system in a tactically believable situation. The intelligence expert must help assess the response the enemy might pose to the deployment of the system.

Through simulated combat engagements, between forces large enough to bring all the important system interactions into play, we can begin to achieve an appreciation and, ultimately, a quantitative set of measures of the utility, in the real world, of a new weapon system.

Operations research and systems analysis have been, and still are, to a large measure, disciplines that permit assessment of alternatives. They have historically been used to decide for or against the introduction of a new weapon system, and nearly never used well in the creative design of new systems or tactics.

I think that, as you study the nature of the very sophisticated studies the Army is now doing, studies like Tataws and Redlegs, you will see the bigger possibilities I envision for us. The studies now in progress have the depth and breadth required to allow us to measure the utility of new systems, and the flexibility to permit the necessary redesign of the Army structure to exploit new systems.

Soon, it should become possible to introduce a new element into the

Army R&D system. The team approach to evaluation of new systems has nearly matured. As we develop confidence in the merit of systematic evaluation, using teams representing all the necessary disciplines, we can look forward to doing something better than just responding to the proposals of our development community.

The large Army studies are really redesigning the Army, to accept that which is well conceived from today's technology and to reject that which is not. Why should we not use the same sort of team, supplemented perhaps by a few imaginative designers, to create the hardware concepts for the future Army?

Systems analysis, to be acceptably professional, clearly needs all the skills required for the design of systems to fit the needs of the users. The Army has learned to analyse. If we learn to use the same tools to design, we can hope to accelerate the pace of innovation, and bring the Army of the future to the troops of this generation. This is the challenge that lies before you.

# **A COMMANDER LOOKS AT OPERATIONS RESEARCH AND SYSTEMS ANALYSIS**

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**A**t the outset, let me emphatically state as the theme of this article that the commander must strike a balance between the precise data provided by the scientist and the extrapolations of the statistician. The commander cannot sit back and expect polished conclusions and recommendations to be handed to him on a silver platter. He has to maintain close contact with the analyst.

The commander must first provide proper and, in some cases, detailed guidance to the analyst. But it is a two-way street. The analyst, in turn, must provide objective analysis to the decision-maker or commander.

I would like to develop these thoughts in general terms. I will, in so doing, cite some specific examples which illustrate the very close and continuous relationship which must exist among all persons involved in the decision-making process.

To begin at the beginning, perhaps the single most important ingredient to a successful study, or program, is the statement of the problem. Too often, we, particularly the military, are reluctant to ask, what is the problem? Not only is it important that we make certain

that the analyst understands the problem, it is far more important that the decision-maker understand just what is it that he wants to know. So important is this understanding that it is well to take the time to find out what is behind the question. This can best be done by an analyst and decision-maker sitting down with each other in the formulation stage and working together. They should continue to work together until the study is finished.

As an example, we currently have a study to determine the optimum mix of artillery weapons in a field army, and the question of criteria for engaging targets has caused considerable concern. Will the study prescribe rules of engaging only those targets for which a damage threshold and attack criteria are previously established? Alternatively, will it permit attack of some "high-value" targets even though the predetermined damage threshold level is not forecast for the amount and type of fire that can be delivered? If the latter approach is to be followed, how are these "partially accomplished missions" to be accounted for when determining the goodness of a particular mix?

Our discussions brought into focus the view that the rules de-

ciding whether a given target is to be engaged in the simulation of candidate artillery mixes, and how much fire is to be delivered, are significant to the results of the study. In the simulation, the rules interact in a complicated fashion with factors which characterize the performance of weapons systems and with other factors which characterize the targets in the time-sequenced fire mission list. Therefore, the calculated performance of a weapons mix, and hence the appraisal of the mix's overall worth, is dependent upon the engagement rules used in the simulation — this even though normally it is difficult to anticipate precisely the impact of a given rule on simulation results. Moreover, the rule problem actually is more tricky in the simulation than on the battlefield, for the computer model must include unambiguous logic which handles without judgment every conceivable situation, whereas on the battlefield one can depend upon able persons

to interpret sensibly general guidelines and use mature judgment to cater to the unique combination of factors of the moment when deciding the right thing to do. All of these observations reinforced our recognition that the seemingly routine business of choosing simulation rules (such as those of the attack criteria) turn out to be of greater consequence in the study than might be thought. This can only be determined by prior analysis.

A related matter is the complexity of a study. If a major study directive asks 10 or 15 major questions, its chances of a successful ending are heavily compromised before it gets underway. Every effort should be made to narrow a study down to one major question, with four probably the absolute maximum for a reasonable effort and result. The narrowing can only take place after considerable thought, as there are usually many (apparently) logical alternatives or options.



**MAJ. GEN. L. H. SCHWEITER**

Gen. Schweiter is a graduate of Kansas State College, the Command and General Staff College, and the Army War College. He was awarded a master's degree by the Univ. of Missouri.

Gen. Schweiter assumed his present position in Dec. 1968. In Mar. 1968, he had been assigned as Chief of Staff of XXI Corps in Vietnam. From Aug. 1967 to Mar. 1968, he commanded the 173d Airborne Brigade in Vietnam.

Prior to that, in Jan. 1967 he was assigned as Assistant Division Commander of the 101st Airborne Division.

(This article was adapted from Gen. Schweiter's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 10 Oct. 1969.)



However, after much screening effort, the redundant, inconsistent, or secondary, and sometimes supercilious questions can be determined and either eliminated or placed in a category to be answered only if time permits. In this connection, it is suggested that the use of essential elements of analysis invites staffs to pyramid second-order questions on top of one another. The commander must constantly guard against this one. Perhaps the term "major issues" is a more disciplined term which would better serve the need of isolating the gut questions.

Thus far I've talked about the necessity of the decision-maker to provide a simple, straightforward statement of what he needs to know and the necessity for decision-maker and analyst working together to be absolutely certain that the purpose is clearly understood — at the outset and throughout the problem.

Now I'd like to turn to the other side of the two-way street and discuss some aspects of what the commander needs from the analyst.

Probably the most important aspect of a study is a thorough analysis and presentation of the missions and tasks. Once one sets out the various missions and tasks to be performed, and their relative frequency and importance, the study tends automatically to get on track. This process not only locks the study into a logical framework but clarifies the study group's view of the problem. By all means, avoid worst casing. Most systems should be optimized to deal most effectively with their most frequent tasks. Their ability to deal with important but infrequent tasks should not be allowed to drive the analysis unduly. For a ridiculous example: It is more important for

a tank to defeat other tanks than it is for it to swim, or for a troop carrying helicopter to carry combat troops rather than be optimized to evacuate casualties. Yet some analysts (particularly military ones) will blindly attempt to meet all requirements and eliminate candidates on lack of capabilities in difficult fringe areas when they may be the most attractive candidates in the center-line area.

A study should not be used as a vehicle to develop a tricky new methodology, particularly an ambitious simulation. The study itself is usually difficult enough: adding a methodology development compounds the possibilities of failure. In effect, it means two tough studies. The safest approach in a new study is to use a well-established and tested methodology. If there are certain aspects of the previous approach that look questionable due to insight into the problem gained since the previous study, these can be explored by sensitivity analyses. This is not to say that a methodology can't be cleaned up and tightened. This is good and should be done, but don't make any radical shifts in logic or factors.

On the other hand, don't hesitate to make a change when indicated.

For example, in the specific matter of "attack criteria" in our artillery study, we moved somewhat reluctantly toward the idea that a single damage threshold criterion to be uniformly applied for all targets simply may not be adequate for the study. Perhaps the fundamental observation was that not all (or even any two) targets are "alike," and that, consequently, on the battlefield it sometimes would be entirely proper to execute a particular fire mission, even when high casualties could not be inflicted; whereas on other occasions a potential fire mission properly should

be deferred or passed up entirely. Thus, it was argued that there are substantial differences in the fundamental nature of the various targets on the fire mission lists, and to ignore these differences in the simulations is to ignore the reasons why in practice one would attack one target and not attack another target even though he might predict that he could inflict the same casualty fraction in both cases. The idea that all potential fire missions are not necessarily of equal importance or "worth" was in no sense novel. The recognition that experienced Army officers would have different views regarding relative importance was also not new. On balance, however, the advantages to be gained by admitting that real differences exist seemed to warrant the added effort to at least grossly quantify them. This then would permit consideration of variable attack criteria which incorporate contingencies based on target nature. But, of course, it could not completely duplicate the judgment of a military commander on the field of battle.

Another very important requirement is objectivity — and, I might add, a very difficult one to achieve. All of us are a product of our own experience and our judgments and views are colored by our prejudices.

The cardinal rule is to try to do a study which honestly searches for the balanced answer to a problem. If this is done, the answers tend to come out in the ball park. Any tendency to "stack" a study for or against an idea should be resisted. This admonition sounds unnecessary, because all parties are for objectivity in principle. However, in practice, each special interest is for a study which objectively proves out its preconceived ideas or its institutional bent. In

addition, there are always a few enthusiasts who just know that a good study will prove out their pet idea. In practice, then, a study must give full credence to the ideas of each of these claimants and let them stand or fall on their own merits against the missions visualized. The perfect study would probably please no one, as the more balanced answers tend to fail in the middle ground. To conclude this thought, if all concerned work for objectivity, the study tends to come up with the "best" answer. If the study group feels it must come up with a particular answer, it is in constant intellectual and analytic difficulty.

In this connection, it is of vital importance to point out to the decision-maker, or commander, the biases and short falls of the study, such as the impact of the parameters used — what they fail to do as well as what they do. We have already seen how a small change in the attack criteria might influence the decision on the type of artillery weapons in a force — a very vital decision — in the absence of certain knowledge to the contrary, it must be assumed that the decision-maker is not sufficiently familiar with analytical techniques to detect the nuances, short falls, and omissions. A close rapport and constant interchange of ideas are essential to assure this.

Simulations are a real problem. Somehow the idea has gotten around that a big complex simulation which purports to reproduce combat gives credible answers. It may; and very often may not. The more complex the military problem, the more difficult it is to attack with a simulation. The difficulty is that there are so many input variables that can influence the answers in undetermined ways that one can't rely on the answers. For example,

in an artillery simulation small changes in the target posture sequence can cause large changes in results. Of course, if every input could be subjected to detailed study and sensitivity runs, this problem would be solved, or at least alleviated. Unfortunately, this is not always feasible. On the other hand, some simulations are well tested and understood and very useful. A good rule is to have an experienced commander sit down and study the particular situation and write down a reasonable outcome based on knowledge and experience. If the corresponding simulation answers are not roughly the same, something is usually wrong.

Another way of making the same point is to observe that experienced military judgment, subjective judgment if you will, has not become outmoded. Simulations should be used to verify and enhance military judgment, not replace it. When a simulation comes out contrary to "experienced" military judgment,

one of three things is wrong. The "experienced" military judgment is wrong, the results of the simulation have been incorrectly interpreted, or the input to the simulation was biased. In any case, the contradiction must be attacked with complete objectivity and the matter resolved. If you attempt to go up the line with the results of a simulation pointing one way and military judgment pointing the other, you're asking for trouble. In this connection, standard doctrine represents a highly replicated experience, and is sound. Adapting it to new situations is the difficulty.

In closing, the major thought I'd like to leave with you is that the mutual goal of the commander and OR/SA is a truly objective answer to a properly defined problem with due recognition of the counterweighted virtues of analytical and subjective analysis. The job is to come as close to the truth, the whole truth, as is possible.

## NOTES

# ANALYZING DATA ON MUNITIONS EFFECTIVENESS AND WOUNDS

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Throughout the history of armed conflict, combatants have examined wounds and injuries in relation to the effectiveness of their own and their enemies' ordnance materiel. These studies have varied from mere casual observations to the employment of the most advanced technology of physics, biology, medicine, engineering, and computer science. As technology advances, so do the horizons of wound ballistics.

Wound ballistics may be defined as "the study of the relationship between the physical and ballistic characteristics of kinetic energy missiles and blast, and the nature and severity of the wound produced by same in the human body." Such studies would include: (1) the pathology and tissue destruction aspects of wounds, (2) the change in the wound picture when body armor is worn, and (3) generation of effectiveness indices for bullets, fragments, flechettes, etc. Input to a wound ballistics research program may be from animal experimentation, use of models of human tissue (20% gelatine), and field collection of battlefield data on wounding and weapons. Excel-

lent summaries of the wound ballistics data on battle casualties from World War II and the Korean conflict may be found in the monographs of Coates and Beyer<sup>1</sup> and Beebe and DeBakey<sup>2</sup>.

Until the Vietnam conflict, efforts to collect field data on wounds and on munitions effectiveness were limited. In August 1966, the then Army Vice Chief of Staff, General Creighton Abrams, made known the requirement for a study in depth of the wounding capability and effectiveness of the various antipersonnel munitions being employed in Vietnam.

The Wound Data and Munitions Effectiveness Team (WDMET) was organized to fulfill this mission. An all-military team of 43 men with various military specialties was given training in ballistics, weapons, wound ballistics, and data-collection procedures in April and May 1967 at Edgewood Arsenal, Maryland. This trained team was deployed to Vietnam in June 1967 and became fully operational in July 1967. A Marine-Navy team was added in June 1968.

The effort was divided into three phases: (1) data collection, (2)

<sup>1</sup> John Boyd Coates, Jr. and James C. Beyer. *Medical Department, United States Army Wound Ballistics*. 883 p. US Government Printing Office, Washington, D.C. 1962.

<sup>2</sup> Gilbert W. Beebe and Michael E. DeBakey. *Battle Casualties—Incidence, Mortality, and Logistic Consideration*. 277 p. Charles C. Thomas, Springfield, Ill. 1952.

data processing, and (3) data analysis and evaluation. The first phase, data collection, was conducted in Vietnam; the second phase, processing, was conducted by a CONUS WDMET group of 15 people located at Edgewood Arsenal, Maryland. Phase 3 was conducted by the Biophysics Laboratory of the Research Laboratories at Edgewood Arsenal, Md., and by the Army Materiel Systems Analysis Agency and Ballistic Research Laboratories at Aberdeen Proving Ground, Md.

The objectives of the WDMET, as cited in the original WDMET Plan,<sup>3</sup> are:

1. Enhance the lethality of:
  - a. Present weapons,
  - b. Future weapons.
2. Confirm or modify the criteria for estimating weapons and munitions requirements.

3. Develop (mathematically) the dependence of traumatic effects (from medical point of view) of wounds on significant parameters of the causative agent (fragment weight and velocity; bullet weight and velocity).

4. Evaluate and possibly improve protection gear for soldiers (body armor, helmets, and boots).

5. Confirm or modify criteria for estimating medical requirements (units and supplies).

This article can be considered a progress report on the results and, in particular, on how well these goals were met.

This study has far-reaching implications. For example, in the field of munitions performance, it must be recognized that billions of dollars have been and will be invested for weapon systems of the anti-

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<sup>3</sup> Wound Data and Munitions Effectiveness Team (Vietnam) (WDMET) Plan, dated 6 Apr 1967, United States Army Materiel Command.



COL. JOSEPH R. BLAIR, M.C.

After receiving a B.S. from Duke University and an M.S. from Vanderbilt, Col. Blair did graduate study at Cambridge University. He received his medical degree from Jefferson Medical College and was licensed for medical practice in 1946.

His military career began in 1942 when he was commissioned a second lieutenant in the Army Medical Service Corps Reserve.

He was assigned to his present position in 1966. He was formerly Director of Medical Research at Edgewood Arsenal, and, prior to that, he was Post Surgeon and Commanding Officer of Noble Army Hospital at Fort McClellan.

(This article was adapted from Col. Blair's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 2 Feb. 1970.)

personnel type by the three military departments. To develop estimates of the accuracy of predicted models for estimating the effectiveness of antipersonnel weapon systems, it is mandatory that checks be made under battlefield conditions. This is the justification for WDMET.

The munition systems to be evaluated are (1) infantry systems, (2) artillery support systems, (3) armored systems, (4) surface-to-air systems, and (5) aerial delivery systems. This study concerns itself with primarily the first two and, to a lesser degree, with the remaining three systems.

These are viewed from a systems analysis standpoint. For example, to establish the lethality estimates for a shell, we must collect complete shell fragmentation data. Data on the fragment mass, the fragment velocity, the number of fragments, and the spatial distribution of fragments are needed. In addition, we need to know the presented area function of the target itself. We must also establish casualty criteria; are we seeking to render the individual enemy ineffective for military performance? or to kill him? We also have to know the effect of protective gear: how do body armor, helmets, boots, etc., protect the individual against a particular weapon system?

The TD that was set up to carry out the studies in Vietnam called for a commanding officer, an operations officer, two ordnance officers, two surgeons, four pathologists, two artillery operations officers, two infantry operations officers, one field medical assistant, and one biostatistician. There was to be a total of 16 officers. Thus, the original TD consisted of about one-half medical personnel and about one-half line or combat personnel.

A particular requirement placed on us was that we should be entire-

ly self-sufficient. To fulfill this requirement, we were required to transport all our supplies and vehicles, and to obtain sufficient enlisted personnel to carry out maintenance and operations in the theater. To insure that our unit would be completely self-sufficient, we had such people as an operations NCO, four intelligence technicians, one supply specialist, three wheel-vehicle mechanics, four medical technicians, three medical photographers, three X-ray technicians, three laboratory assistants, and three clerk-typists. We had a total of 27 enlisted men, and this assured us that we would in no way interfere with the local combat missions.

Figure 1 shows the WDMET organizational structure. Team 1 (1967-1968), under Col. Benjamin Freund, had two Data Collection Sections (DCS); Team 2 (1968-1969), under Col. Thomas Ostrom, had three DCS's. Headquarters and the Support Section for Team 1 were located at Tan Son Nhut. In June 1968, when Team 2 took over, WDMET Headquarters and the Support Section were moved from Tan Son Nhut to Saigon. Each Army WDMET had a pathology team operating under the Armed Forces Institute of Pathology as an overseas unit of the U. S. Army Medical Research and Development Command. The third Team was a Marine-Navy WDMET (not shown). All of the data collected by the three teams came back to Edgewood Arsenal for processing, analysis, and evaluation.

Note the Wound Ballistics Working Group shown in Figure 1. This was the advisors' group made up of representatives from the U. S. Army Medical Research and Development Command, from the Office of the Chief of Research and Development of the Army, from the Biophysics Laboratory of the Re-

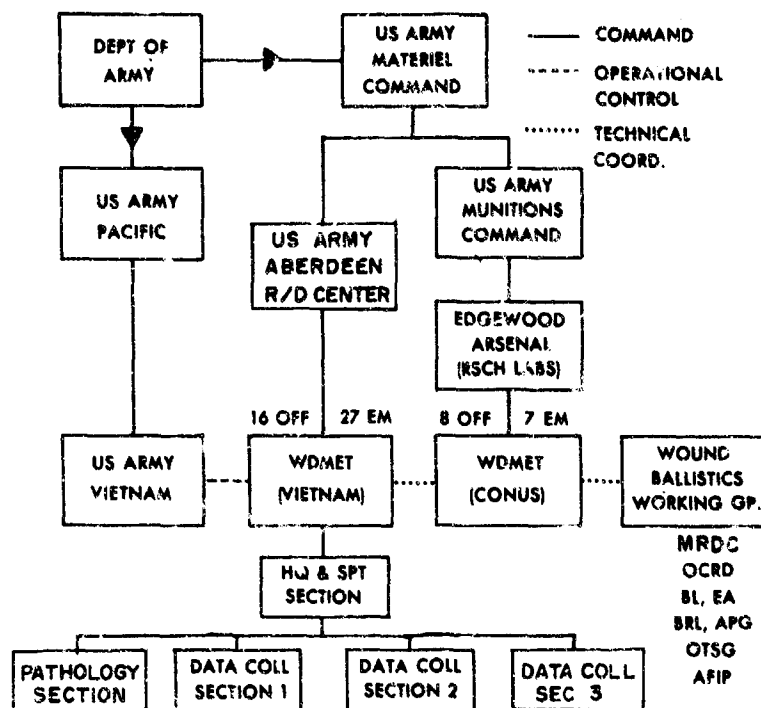


Figure 1. Structure of WDMET organization.

search Laboratories, Edgewood Arsenal, from the Ballistic Research Laboratories at Aberdeen, and from the Armed Forces Institute of Pathology. All have had a part in guiding and directing the technical aspects, reviewing the data, and providing technical guidance to the team in the theater and to the people who were analyzing the data in CONUS.

Figure 2 shows the locations of the various teams in the theater. The Marine-Navy team operated in the RVN I Corps area with the hospital and mortuary at Da Nang providing the medical and pathology support. The first Data Collection Section (DCS-1) of Army Team 1 (1967-1968) operated at An Khe with the 1st Cavalry (Air Mobile); DCS-2 of Team 1 operated with the 25th Infantry Division in the Cu Chi area. Team 2 (1968-1969) operated in three areas; DCS-1 was attached to the 4th Infantry Division near Pleiku in the

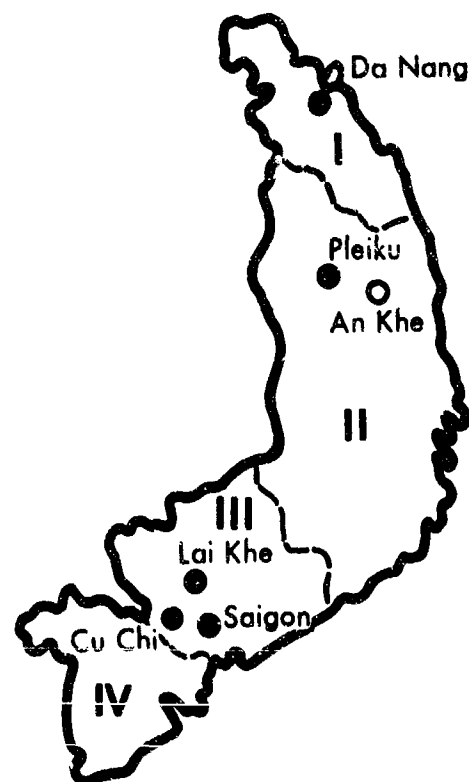


Figure 2. WDMET team locations in Vietnam.

Central Highlands. DCS-2 remained at Cu Chi with the 25th Infantry Division, and DCS-3 (established in August, 1968) collected data with the 1st Infantry Division (the Big Red 1) at Lai Khe.

The data were collected by each team on the basis of a series of eleven questionnaires which were completed on the casualties. These included questionnaires on body diagrams (wound tracts and where wounds occurred); data on the wounding agent (bullet, fragment, or weapon); an autopsy supplement; a medical evaluation; an interview of the casualty; an interview of those who might have been nearby or accompanying the casualty; a burn supplement (whether from napalm or other causes); body armor (whether there was a hit or deflection); complete tactical scenario; and troop interview (to give a complete picture of the tactical operation itself).

Other inclusions were the following: photographs or negatives; X-rays; drawings (with scenario); recovered missiles (bullets, fragments); a caption sheet; body armor (helmets, boots, vests); pathology specimens; and others. Pathology specimens taken at the time of autopsy were sent back to the Armed Forces Institute of Pathology for further microscopic examination.

Figure 3 illustrates a typical engagement covered. This was at LZ Uplift, one of the landing zones operated by the 1st Air Cavalry Division, which was shelled by the Vietcong.

The purpose of the 1st Battalion, 5th Cavalry, stationed around the LZ, was to protect a bridge leading over a certain river; a hill overlooked their position. Between the hill and the bivouac area of the troops was a barbed wire enclosure. One morning around 0200 the Vietcong positioned themselves on the

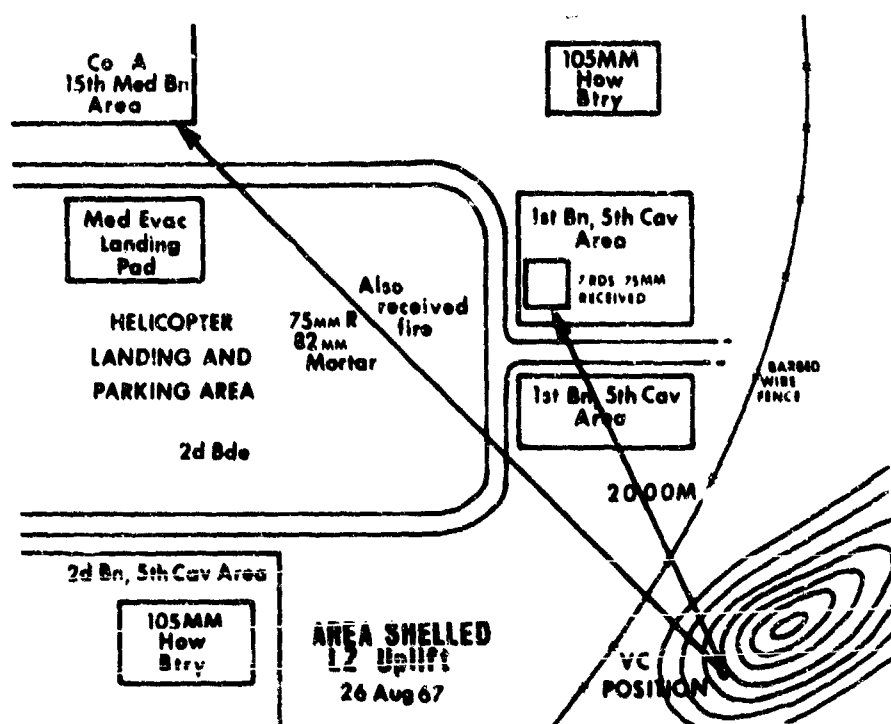


Figure 3. Diagram of engagement at LZ Uplift.



hill and fired mortars and 75-mm recoilless rifles (seven rounds) into the area.

Figure 4 shows the impact area, the rounds having landed in the places indicated. The first round, in the lower right, slightly wounded one man in the mess tent. The second round slightly wounded another man, 40 feet away in a communication bunker. The third, fifth, sixth, and seventh rounds did not wound anyone; the *fourth* round came in through the top of the casualty tent.

Figure 5 shows the inside of this casualty tent, which was completely surrounded by sand bags. The occupants (9 in all) were sleeping in their bunks. In this particular case, the round hit 2 feet away from two of the men, who were killed, and 6 feet away from three others, who were wounded seriously. Three men were slightly injured, and one man was not injured at all.

This was an important case to us, because we knew the weapon,

we identified the round, we knew the range, we had data on the position of the men, and, thus, we were able to establish the effectiveness of this particular round in this particular area under these circumstances. All the people were studied by the doctors, surgeons, and pathologists; the weapons were evaluated, and this gave us firm information on all possible aspects.

Table I gives the status of cases as a progress report on the number of cases investigated to date. The number of cases collected by WDMET in Vietnam total 7,801, drawn from a total of 2,734 combat engagements. The teams were attached to platoons or companies that went into the combat areas. They got first-hand information on any wounded and followed up at the hospitals when the wounded men came back for treatment.

At Edgewood, we are evaluating all the cases we have logged in. We have received 7,801 cases, but only

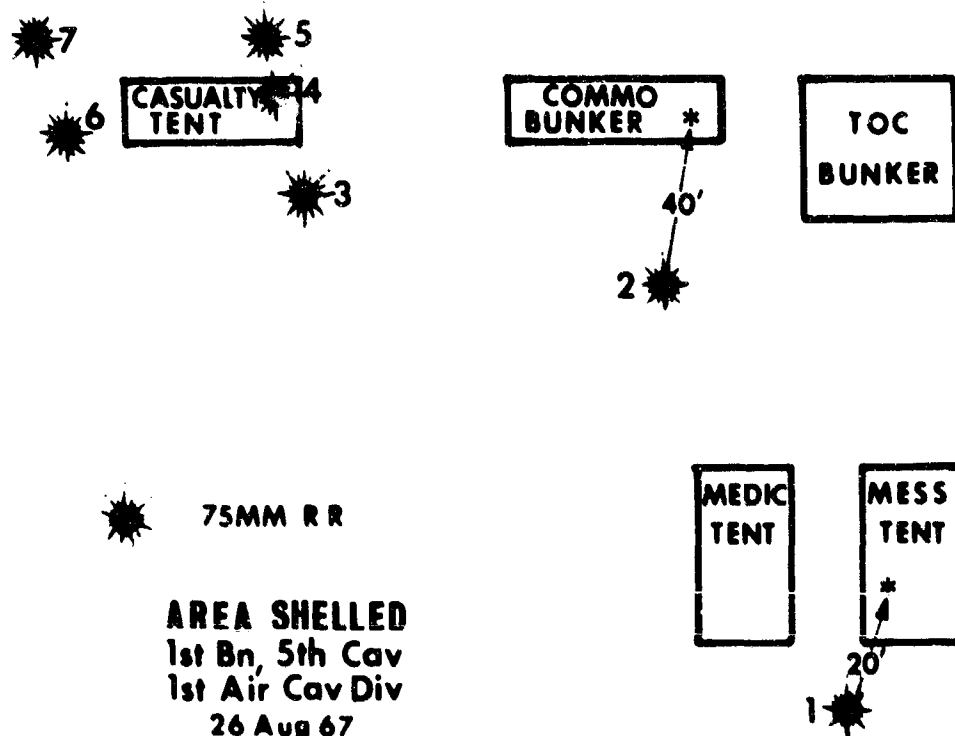


Figure 4. Diagram of impact area.

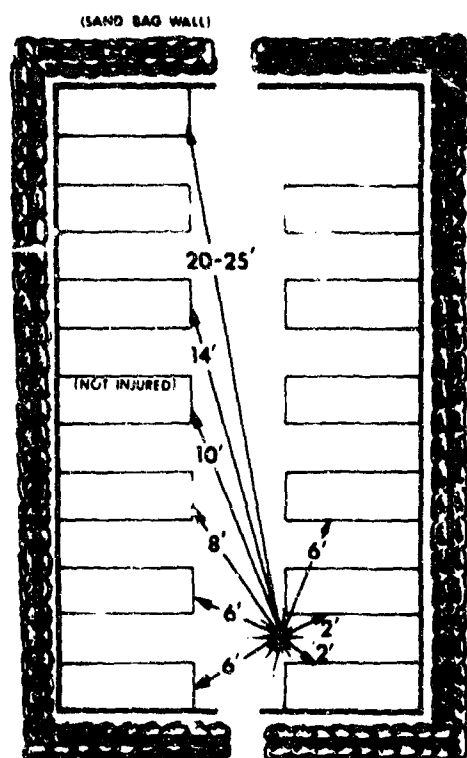


Figure 5. Casualty tent, 1st Bn., 5th Cav.

5,463 had been coded and put into the computer by 15 January 1970.

Whereas much of the raw data from both World War II and Korea have been lost and cannot be retrieved, all of the WDMET data will be permanently stored and available to the user at any time. All the data are being coded and put into the computer at the US Army Aberdeen Research and Development Center, Aberdeen Proving Ground, Md. Requests for this information should be directed to the CO, Aberdeen Research and Development Center, Aberdeen Proving Ground, Md. The actual medical records, X-rays, photographs, and questionnaires are being processed, indexed, and permanently stored at the Armed Forces Institute of Pathology at Walter Reed Army Medical Center, Washington, D. C., and will serve as a bank of very valuable information for many years to come.

Table I  
Status of WDMET Cases

	Army	Marine	Total
Engagements	1,867	867	2,734
Number of Cases	5,993	1,808	7,801
Cases by WDMET-C	5,993	1,808	7,801
Cases Coded	3,655	1,808	5,463
Cases on Computer	3,655	1,808	5,463
Cases to AFIP	1,777	789	2,566

Table II shows the casualty types and their distribution. For example, out of 7,801 cases, 6,351 or 83.4 percent were wounded in action, 1,151 or 15 percent were killed in action, and 118 or 1.6 percent died of their wounds. The "autopsy only" cases are not counted with

the others. These are cases that came to the mortuary showing that body armor had been hit under unusual circumstances. In these cases we desired information or data from the pathologist on casualties which were not seen by the team in the combat zone.

Table II  
Casualty Types

Casualty Types	Army	Marine	Total
WIA	4,714	1,637	6,351 (83.4%)
KIA	995	156	1,151 (15.0%)
DOW	103	15	118 ( 1.6%)
Autopsy Only	181	0	181
<b>Total</b>	<b>5,993</b>	<b>1,808</b>	<b>7,801</b>
<b>Accidents</b>	<b>853</b>	<b>159</b>	<b>1,012</b>
	(14.2%)	(8.8%)	(13.0%)

I should explain what we mean by accidents. The figure of 13 percent for accidents, shown in Table II, does not mean that 13 percent of all casualties fall into the accident category. When an accident occurred from which we could obtain valuable information on a weapon, we moved our people in very quickly to get all information possible on the accident. This resulted in 13 percent of the cases covered being "accident" cases. The actual accident proportion of *all* casualties is probably very small, less than one percent.

Table III shows actual U.S. battle casualties in Vietnam from 1961 through 1968. I refer to this table,

because some people have asked how representative are the samples of what has happened in Vietnam during the mentioned period. Our samples may not be fully representative of the entire situation; they really only apply to the operations where our teams were located. However, they do correspond fairly well to the total casualty distribution. For example, at the bottom of Table III you will notice that 11.6 percent of all casualties are men killed in action. As you may recall, our comparable figure was 15 percent. Likewise, Table III shows 1.4 percent of all casualties as having died of wounds whereas our comparable figure is 1.6 percent. Our figure of

Table III  
Total Casualties in Vietnam (1961-68)

Service	Casualties			Total
	KIA	DOW	WIA	
Army	9,672	1,188	70,818	81,678
Navy	494	64	4,166	4,724
Marines	5,958	721	45,220	51,899
Air Force	240	25	1,813	2,078
<b>Total</b>	<b>16,364</b>	<b>1,998</b>	<b>122,017</b>	<b>140,379</b>
	(11.6%)	(1.4%)	(87.0%)	(100%)

83.4 percent wounded in action compares with the 87 percent shown in Table III. So, at least from the standpoint of types of casualties, our samples seem to be fairly representative of the action in Vietnam.

Table IV shows the types of supporting material which we have received from Vietnam for further identification studies on 7,801 cases. We have fragments or bullets removed by the surgeon or pathologist on 1,810 cases, 922 of which have been identified in the laboratories. We had a total of 52 cases with helmets and 168 cases with

body armor. Most of the cases of body armor came from the Marines, who, because of their operational situation and the command policy of using body armor, seem to provide more body armor cases than the Army. There were 45 cases involving boots and 5,736 cases involving photographs and X-rays; there were 409 cases involving tissue specimens from autopsies. Qualified users will have access to this material at the Armed Forces Institute of Pathology, Washington, D. C.

Table IV  
Material Received from Vietnam  
(on 7,801 Cases)\*

Material	Army	Marine	Total cases
Fragments or Bullets	1,430	380	1,810
Helmets	46	6	52
Body Armor	49	119	168
Boots	24	21	45
Photographs and X-Rays	4,045	1,691	5,736
Tissue Specimens	---	---	409

\*2,666 complete cases (with material) accessed by the Armed Forces Institute of Pathology (AFIP).

Table V shows the types of weapons verified and suspected on the same 7,801 cases. (The total in some cases is a little greater, because some people were hit by more than one type of weapon.) I think the interesting thing about this is that the number of gunshot wounds total up to about 30 percent of all wounds. This differs from World War II and Korea, where bullet or gunshot wounds accounted for only about 15 percent of wounds. Because of the operational aspects of the Vietnam war, gunshot wounds

have been approximately double those of World War II and Korea. Most of the wounds have come from various types of fragmentation weapons, such as mortars, rockets, grenades, and mines.

Figure 6 shows why we must have this information in our weapons effectiveness program. In the laboratory we do validation experiments. Animals and blocks of 20 percent gelatin are used to simulate human tissue. From this we develop predictive models of the wounding capabilities or effectiveness of various weapons and weap-

Table V  
Types of Weapons — Verified and Suspected  
(on 7,801 Cases)\*

Weapons	Army	Marine	Total
Gunshot Wound (M-16)	1,685	537	2,222
M-16 Rifle	127	35	162
"Booby Trap"	611	511	1,122
Mortar/Rocket	860	209	1,069
RPG (all types)	937	20	957
Hand Grenade	606	180	786
Mines (various)	390	56	456
Rifle Grenade	227	44	271
Artillery	203	36	239
Bomb	57	36	93
Recoilless Rifle	84	4	88
Flame	31	25	56
Unknown	338	105	443
<b>Total</b>	<b>6,156</b>	<b>1,808</b>	<b>7,964</b>

\*Some cases involve more than one weapon.

on systems. Battlefield data are necessary to determine whether our laboratory predicted models are comparable. (As you can see, in Table V, we broke out the M-16 data separately from the other data, because the Under Secretary of the

Army desired a special evaluation of the M-16 rifle in Vietnam.)

Figure 7 shows models of wounds caused by the AK47 rifle. The scale is 20 centimeters. The lower part of the figure shows the wounding capability from entrance to exit of an AK47 round based on 17 experiments at Edgewood at a range of approximately 50 meters and a striking velocity of 680 meters per second. We had one well-documented case in Vietnam at about the same range and striking velocity. You will note that the actual observed case in Vietnam (see upper part of Figure 7) follows very closely the predicted model of the performance of the AK47 from the wounding capability standpoint.

Now, we were somewhat fooled by the M-16 rifle, as can be seen in Figure 8. Here you can see the predicted wound caused by an M-16 rifle bullet at a scale of 20 centi-

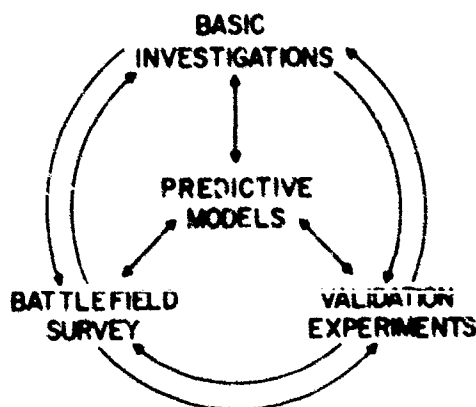


Figure 6. Military systems analysis cycle.

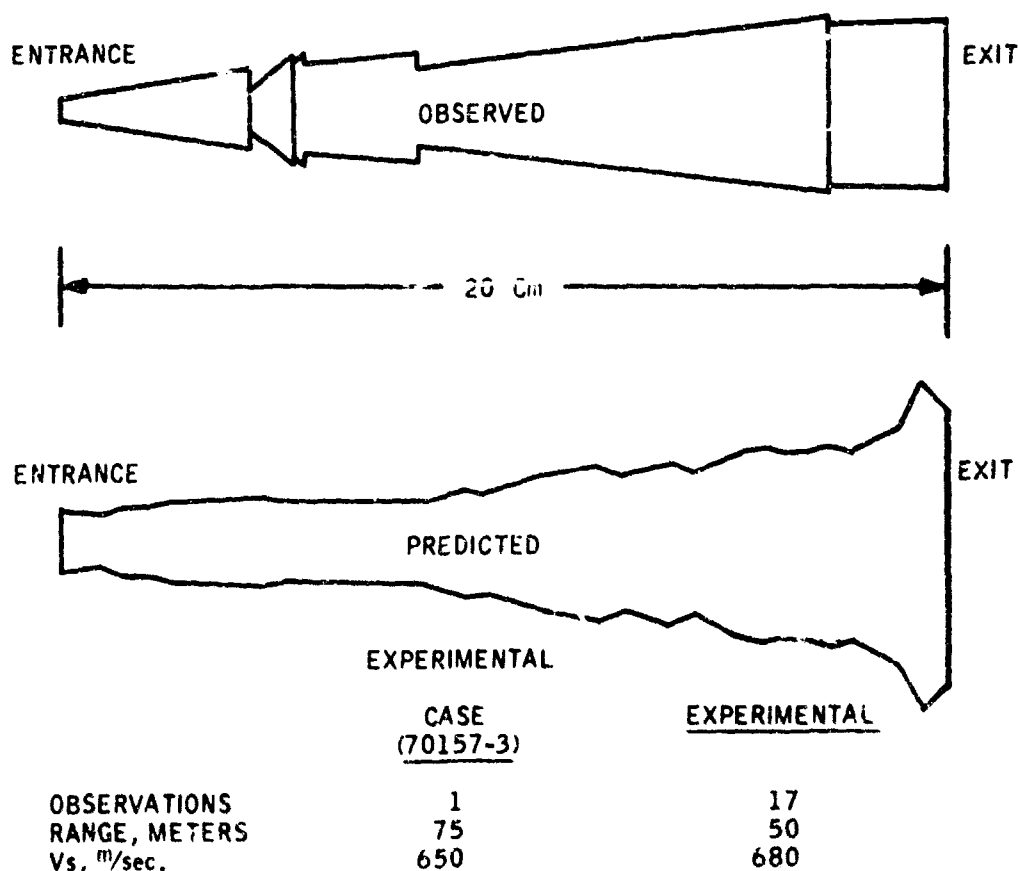


Figure 7. Predicted and observed models of wounding by AK-47.

meters. Three experimental observations were made in the laboratory at a range of 25 meters and a striking velocity of 937 meters per second, about 50% greater than the striking velocity of the AK47. However, when we looked at the data from Vietnam (see upper part of Figure 8), we were surprised to see a different wound pattern, one differing considerably from the wound pattern predicted by our laboratory studies. Note particularly the "keyhole effect" in the upper part of Figure 8 caused by the increased entrance damage; this is in contrast to the predicted composite.

After being puzzled by this, we eventually found out why this occurred. When we ran the tests at Edgewood, we took a new rifle,

which is cold and fired under what could be called ideal conditions. We arrived at our data on that basis. As is well known in Vietnam, the M-16, when fired automatically or semi-automatically, becomes quite hot. When this occurs, the bullet loses some of its stability and tends to a greater yaw. When the bullet loses stability and hits at a yaw on the target, there is a greater initial expenditure of energy in the tumbling and damaging effect. We repeated our experiments at Edgewood and found this to be correct. Thus, our original prediction of the M-16 was much on the conservative side.

We also wanted to look at the range in use of the M-16. Figure 9 gives data on this. Some years ago,

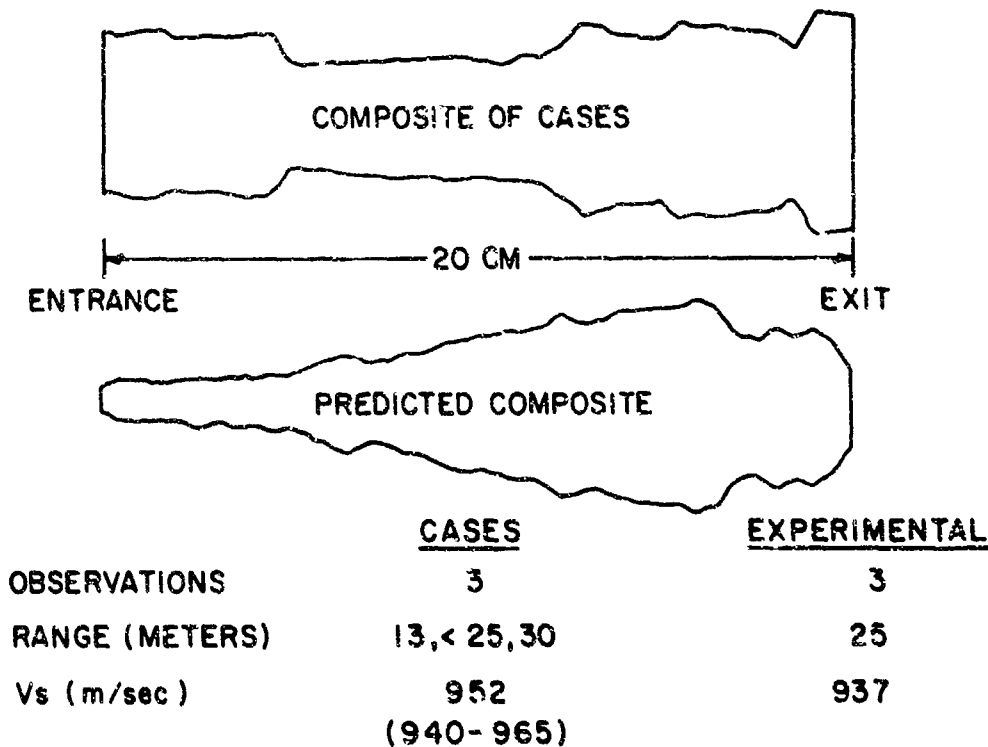
WOUNDS CAUSED BY M-16

Figure 8. Predicted and observed models of wounding by M-16 rifle.

the Operations Research Office, in conjunction with the Research Analysis Corporation, did a series of studies on munitions known as the Salvo series. Salvo I was the predicted cumulative engagement range of the M-16 rifle based on employment in a European-type theater. Figure 9 represents use of the M-16 at various ranges in meters. Actually, you will note that the WDMET data from Vietnam show that the weapon is being used at ranges much shorter than those shown by the predicted data. The M-16 rifle is being fired at much closer range because of the operational aspects, the terrain, and the geography. So, again, from the standpoint of operational use and research, the data are on the conservative side, compared with data derived from actual use in the combat theater.

Table VI shows the results of a study that we did for the Infantry

School at Fort Benning, Ga. They were interested in the posture of individuals in combat situations with respect to the vulnerability of being wounded. We have posture data on 1,372 cases of individuals who were wounded in Vietnam. As can be seen in the table, about 50 percent of these individuals were wounded in an upright position, about 20 percent were wounded in a lying position, and smaller percentages were wounded while kneeling or sitting. Some (about 3 percent) were wounded while in positions that remain unknown to us.

The second column of figures in Table VI represents the percentage of time the individual was in a certain position during an engagement. As might be expected, about two-thirds of the time the individual was lying in a prone firing position. Less time, 19 and 13 percent, respectively, is spent in the kneeling and upright positions. Individ-

## % CUMULATIVE ENGAGEMENT RANGE

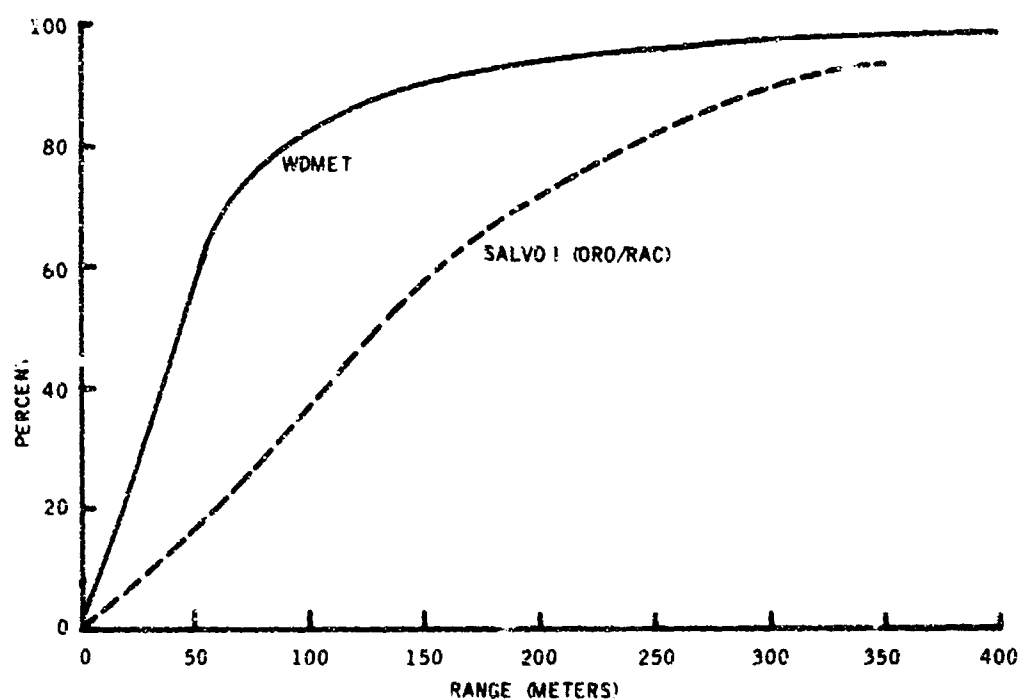


Figure 9. Cumulative engagement range of the M-16 rifle.

Table VI

## Posture and Vulnerability to Wounding

Combat Posture	Number in posture	% Time in posture	Vulnerability Index*
Upright	690 (50.3%)	13.5%	51.1
Sitting	201 (14.6%)	4.5%	44.7
Kneeling	167 (12.2%)	19.0%	8.8
Lying	270 (19.7%)	63.0%	4.3
Unknown	44 (3.2%)		
<b>Total</b>	<b>1,372 (100%)</b>	<b>100%</b>	<b>13.7</b>

\*Vulnerability Index-Casualties per 1% of Combat Time.

uals are usually found in the sitting position when they are ambushed or caught unaware.

We have developed what we call a vulnerability index (shown in the last column of figures in Table VI) which indicates the number of casualties per percent of combat

time. As might be expected, there is a high vulnerability in the upright position and in the sitting position, primarily because these are relatively unprotected positions in which unaware individuals find themselves.



Table VII shows the number of casualties by causative agent, based on 1,173 cases. This is further broken down into fatal and non-fatal casualties. According to the data, the ratio of fatal to nonfatal casualties is 0.64 in the case of small arms as a causative agent, 0.18 in the case of fragmenting munitions as a causative agent, and 0.21 in the case of such improvised weapons as booby traps. This in-

dicates that if hit by small-arm projectiles, one is probably three times as likely to die from a wound caused by such agents as from wounds caused by fragments or booby traps. This does not mean that small arms are three times more effective than fragments or booby traps. However, if one is hit by a bullet, one's chance of surviving is about one-third of that if hit by a fragment.

Table VII  
Fatal and Non-Fatal Wounds by Causative Agent  
(on 1,173 Cases)

Causative Agent	Number of Casualties		Ratio Fatal to Non-Fatal
	Fatal	Non-Fatal	
Small Arms	151	237	0.64
Fragmenting	72	392	0.18
Improvised (Booby Trap)	27	127	0.21
Miscellaneous	3	15	--
Other	41	108	--
Total Sample	294	879	

Table VIII shows WDMET data on the distances from the casualty-causing weapon to the casualty. As can be seen, more than half, 58.7 percent, of all casualties occur within 10 meters from the causative agent. Much fewer casualties (less than 10%) are caused at distances greater than 50 meters.

Figure 10 shows the distances at which casualties received non-fatal wounds. The data are broken down into fragments and bullets.<sup>1</sup> As one would expect, bullets produce non-fatal wounds at greater distances than do fragments. You will note

that about 60 percent of all non-fatal wounds caused by fragments occur within about 10 meters, while about 60 percent of those caused by bullets occur within about 40 or 50 meters.

Figure 11 shows the distances at which casualties received fatal wounds. Here we see that the curves move to the left and that fragments are able to cause fatal wounds at close distances. About 90 percent of the fatal fragment wounds occur at a range of less than 30 meters. Bullets produce the same cumulative percentage at 100 me-

<sup>1</sup> W. Bruchey, L. Sturdivan, and R. Whitmire. *Analysis of Data from the Wound Data and Munitions Effectiveness Team in Vietnam*. ARO-D Report 69-2, Durham, N. C., p. 191-211 (1969).

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Table VIII  
Weapon-to-Casualty Distance

Distance (In Meters)	Casualties	Percent
0 - 10	1,311	58.7
11 - 50	702	31.4
51 - 100	127	5.7
101 - 200	55	2.5
201 - 300	27	1.2
301 - 400	4	0.2
401 - 500	5	0.2
500	3	0.1
<b>Total</b>	<b>2,234</b>	<b>100.0</b>

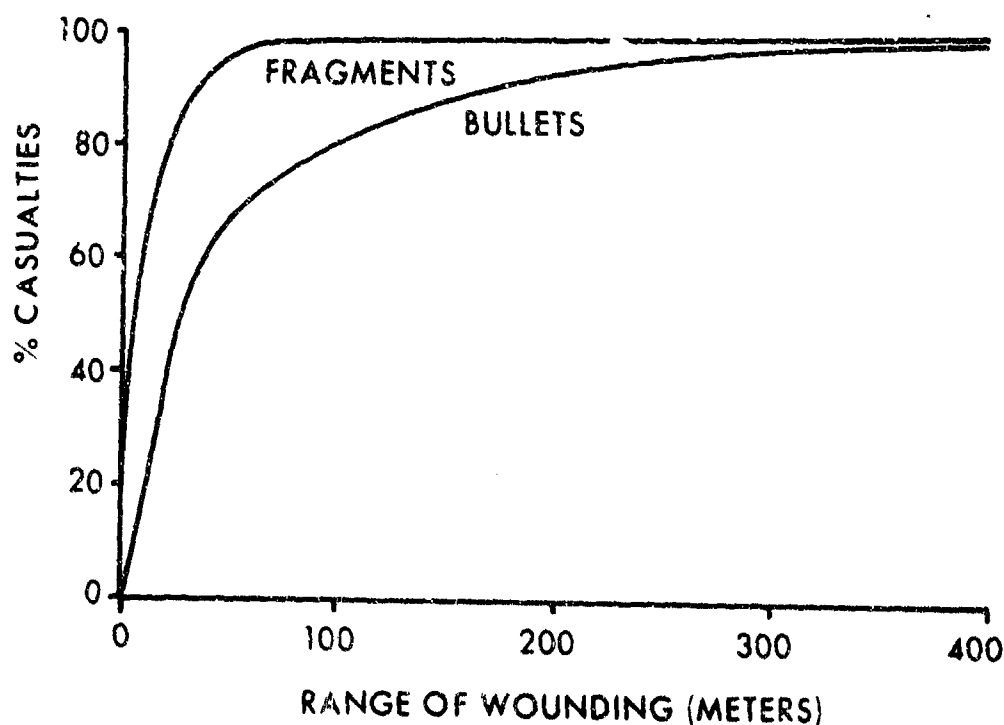


Figure 10. Distance at which casualties received non-fatal wounds.

ters as fragments do at 5 to 10 meters.

Table IX gives data from Vietnam on the distribution (according to body area) and lethality of hits,

based on 3,200 Army cases. The total number of body areas hit is 6,764. The total number of hits is 11,206, so that there are about four hits per individual, on the average.

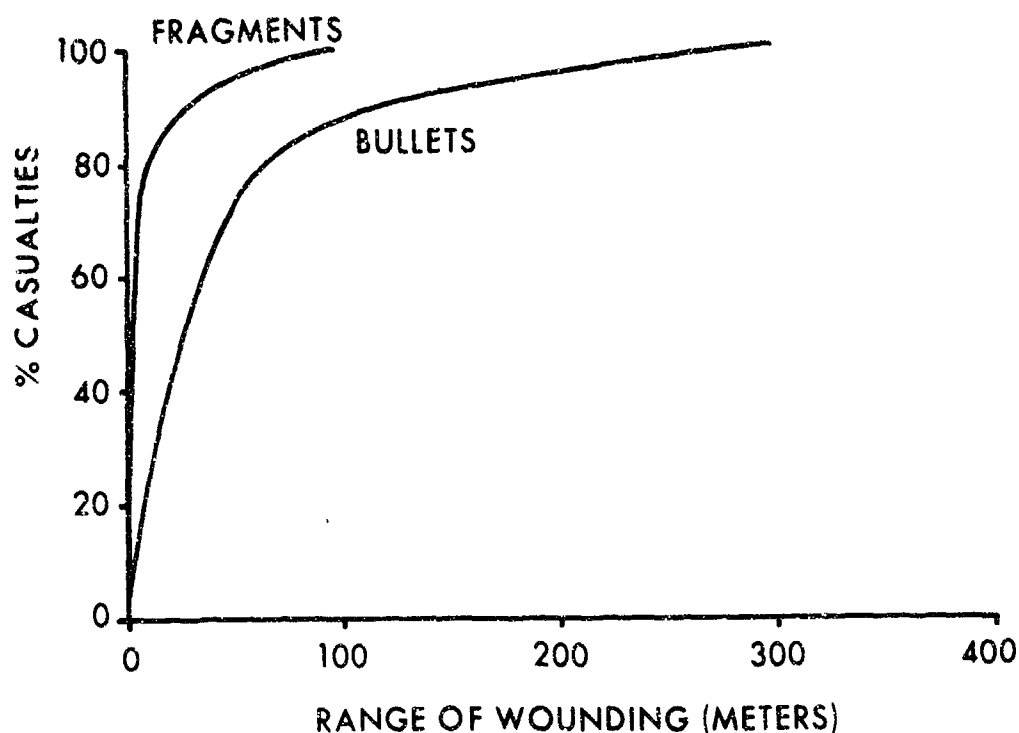


Figure 11. Distance at which casualties received fatal wounds.

Table IX

Distribution and Lethality of Hits  
(Based on 3200 Army Cases)

Body Area	Presence of Hit	Number of Hits	Cause of Death	Hit/Death Ratio
Head	470	612	117	4
Face	480	711	40	12
Neck	315	431	34	9
Thorax	841	1,539	179	4
U. Abdomen	298	422	30	10
L. Abdomen	158	213	10	16
Pelvis	311	498	10	31
Buttocks	123	223	3	41
Thigh	779	1,745	12	67
Knee	313	472	1	313
Leg	620	1,382	4	155
Foot	224	336	—	—
Shoulder	323	407	14	23
Arm	507	755	2	254
Elbow	182	228	—	—
Forearm	472	733	—	—
Hand	348	499	—	—
<b>Total</b>	<b>6,764</b>	<b>11,206</b>	<b>456</b>	

# **[140] ANALYZING DATA ON MUNITIONS EFFECTIVENESS & WOUNDS**

As one might expect, the highest percentage of fatal hits occurred in the head. There is a lesser percentage of fatal hits in the face and neck. Arms and legs received a very small percentage of fatal hits.

Table X shows data collected in Vietnam for the purpose of determining where we should place body armor on the soldier to get the greatest degree of protection. From

the data, it appears that considerable fire is aimed at vulnerable areas; or it may be that soldiers were hit while looking out from a foxhole or from behind a tree. It can be seen, however, that 84 percent of all deaths in Vietnam are due to hits on the head, face, neck, thorax, and shoulders. It is in those areas that we should place body armor to get the greatest protection.

Table X  
Hits by Body Area and Cause of Death  
(Based on 3200 Army Cases)

Body Area	% of Total Body Area	% of Total Hits	Cause of Death (%)
Head, Face, Neck	6.5	15.5	42.0
Thorax, Shoulder	13.0	17.5	42.0
Upper Abdomen	10.6	4.0	7.0
Lower Abdomen, Pelvis, Buttocks	11.6	8.0	5.0
Thigh, Knee, Leg, Foot	37.8	35.0	3.5
Arm, Forearm, Hand	20.4	20.0	0.5
Total Sample (No.)		11,206	456

Table XI gives data on the frequency of wearing armor in Vietnam. We see first the type of body armor worn by the Army and then the type worn by the Marines. As would be expected, it is the Army which chiefly uses its issued body armor and the Marines which use their ballistic nylon and doren armor. It is interesting to note that the Army, because of the heat and humidity on search-and-destroy missions, does not use body armor as often as the Marines, who are in more static positions by command policy.

As can be seen, the percentage of Army soldiers wearing body

armor is about 26 percent, or one in four. The corresponding percentage for the Marines is 89 percent, or about nine out of ten. This was one of the reasons why we needed the participation of the Marine team in order to get more data on body armor.

The percentage of those wearing helmets was about 60 percent (3 out of 5) in the Army and about 75 percent (3 out of 4) in the Marines.

A year or so ago, an interesting suggestion came to us on how to overcome the weight of body armor. Fighting in armor in the intense heat and high humidity was debilitating to our soldiers. This was

Table XI  
Frequency of Wearing Body Armor

Type Vest Worn	Army	Marine
Army 12-Ply Ballistic Nylon	214	5
Marine Ballistic Nylon & Doron, 1955	11	122
Army Aircrew. Ceramic Fiberglass	32	0
Other Types	28	0
Unknown Types	43	30
<b>Total Wearing Vest Armor</b>	<b>328</b>	<b>157</b>
<b>Total Not Wearing Vest Armor</b>	<b>898</b>	<b>18</b>
<b>% Wearing Vest Armor</b>	<b>26.7</b>	<b>89.7</b>
<b>% Wearing Helmet</b>	<b>59.5</b>	<b>73.5</b>

particularly true in search-and-destroy missions. It was suggested that a baseball type of chest protector be placed on the soldier; this would not only cut the weight in half but would also provide for more air ventilation which would decrease body heat.

Based primarily on graves registration information from the mortuary, the majority of all hits were on the front of the body rather than on the back of the body. Actually, this appeared to be contrary to information which had been developed from World War II and Korea, so we decided to look into this particular aspect. Knowing mortuary operations, we suspected that bodies are seldom turned over to observe the back. We also knew that any completely perforating wound was usually described as having its entrance in the front and its exit in the back. Of course, it takes a very fine forensic pathologist to be able to identify the point of entrance and point of exit of a perforating wound.

We looked at all of our data from the standpoint of hits in the front and back, as related to bullets and fragments, and assembled them in Table XII<sup>1</sup>. The table summarizes front and back wounds for the Army. For fragments, the Army had 51.9 percent front wounds and 48.1 percent back wounds. For bullets, the Army had 62.3 percent front wounds and 37 percent back wounds. All in all, the data pointed out once again that, to give a man adequate protection in body armor, we have to protect both his front and his back.

To conclude, I should mention that WDMET ceased to operate in Vietnam as of June 1969. It was phased into a tri-service (Army, Navy, Air Force) operation and given the name of Battle Damage Assessment Reporting Team (BDART). The purpose of this team is to look at the effects of weapons on materiel rather than on personnel. We are starting to receive information from Vietnam on the effects of various weapons and munitions on hard targets, such as

<sup>1</sup> W Bruchey, L. Sturdivan, and R. Whitmire. *Analysis of Data from the Wound Data and Munitions Effectiveness Team in Vietnam*. ARO-D Report 69-2, Durham, N. C., p. 191-211 (1969).

Table XII

Comparison of Front and Back Wounds

	Front		Back	
	Number	Percent	Number	Percent
Fragment	409	51.9	379	48.1
Bullet	162	62.3	98	37.7

Note: Adjustment made to account for bias due to helmet protection and ambiguity of front or back arm hit.

bunkers, and on various types of vehicles and aircraft, as well as Navy and Air Force data on hard targets of interest to those services.

In summary, a quotation from Sun Tzu, a Chinese war lord and philosopher of the sixth century B.C.

Sun Tzu stated, "Now, the general who wins a battle makes many calculations in his temple ere the battle is fought.

"The general who loses a battle makes but few calculations beforehand. Thus do many calculations

lead to victory and few calculations to defeat.

"It is by attention to this point that I can foresee who is likely to win or lose."

*It must be stressed that the data in this publication are incomplete, from both processing and analyses standpoints. They are unsuitable, therefore, as the basis for final policy decisions. Until the remaining case material has been coded and thoroughly analyzed, apparent trends must not be accepted as definitive.*

NOTES

# CONTRACTUAL RESEARCH MANAGEMENT

COLONEL BERNARD BRENMAN  
DEPUTY COMMANDER,  
COMBAT SUPPORT GROUP.  
HQ, U. S. ARMY  
COMBAT DEVELOPMENTS COMMAND

In 1963, I had the pleasure of sitting as a participant in the Army Management School senior officers' management course. When I received orders to attend the course, I was convinced that I was in for a snap, with plenty of time to relax, no examinations or tests, no homework, lots of free time, and interesting speakers. I was surprised because none of the above turned out to be so. In my evaluation sheet, after the course was over, I recommended that "a good hard look should be taken at this problem of night work, homework, etc." And, by God, they did take a good hard look at it: They doubled the number of tests; they increased the night work; they increased the homework; they cut out all free time; and they got me for a speaker.

In 1967, when Colonel Fred Jacks, then Deputy Commandant and Director of Instruction of the Management School, was given the mission of setting up an executive-level course in operations research and systems analysis, he contacted as many people as he could who were working in OR/SA executive positions, sent them copies of his proposed program of instruction,

and requested comments. My comments at that time will be the outline for this discussion.

I will sum up my comments as follows. "Our greatest deficiency in contractually supported studies is the lack of management from concept to implementation. Your time is short; your program is large, vital, and important; you don't have time to develop journeymen, so be sure that you don't wind up developing neither fish nor fowl. Be sure that your program is oriented to the executive; be sure that you develop managers." I then listed 12 areas in which the graduates of this school should be qualified. Subsequently, I have updated the 12 subjects slightly. Basically, they remain the same. I'll start out by enumerating the 12 areas and later discuss them. They are:

1. How to recognize that a problem, a data gap, or a knowledge gap exists.
2. Once it is recognized that one exists, define the problem.
3. Conduct a literature search; determine what has been done in the same or similar areas.
4. Develop a work program; be sure that it can be understood by others. Narrow down the objectives. Avoid wide parameters.

5. Determine whether the problem can be solved in house, in house with the use of experts and consultants, in house with contractual support, or out of house.

6. The request for proposal.

7. Establish the Contractor Technical Evaluation Board. Know how to conduct the Contractor Evaluation Board and know how to evaluate the proposals. Be prepared to brief the contractors who failed to get the contract, and be prepared to tell them why.

8. Establish the Project Advisory Group; know how to conduct one.

9. Know how to manage the project.

10. Evaluate the results.

11. Establish the format for the final report and know how to evaluate it.

12. Manage the application of the finished product; the implementation. Please note that the emphasis was placed on recognition, organization, management, evaluation,

and application, and not on the details of how to do the job.

#### **Recognizing the Problem, Data Gap, or Knowledge Gap**

Let me give you an example. We had a contractually supported ongoing study whose objective was to evaluate the capability of high-explosive artillery rounds in specific situations. This was to be followed by an examination of the capabilities of white phosphorus rounds to do the same job. The third phase was to examine the capability of various chemical rounds to do the same job. After completion of the first three phases, the fourth phase was designed to develop and examine the capabilities of various mixes. In this way, we were going to offer any commander the capability of looking at additional options for the accomplishment of a mission.

Phase I was completed most successfully; Phase II was delayed;



**COL. BERNARD BRENNAN**

Col. Brenman enlisted in the Army in 1942. Just after World War II, he separated from active duty to join a Reserve tank battalion and also organize his own construction business.

Recalled to active duty in 1951, he was to serve in Korea, at Fort Knox, in Turkey, at Fort Riley, and on the Army General Staff.

Col. Brenman was Chief of the Organization & Evaluation Division of CDC's Combat Support Group before his present assignment.

(This article was adapted from Col. Brenman's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 17 July 1969.)



Phase III was completed successfully; and then there was a giant-sized thud — nothing happened.

A problem existed. There was a data gap. This had existed for over 25 years. That is, the U. S. Army had no data available on the anti-personnel capabilities of white phosphorus. Again, the problem existed, but it was not recognized. Both the contractor and the military managers of this program were sitting tight, doing nothing, waiting for an unknown society or being to give them some data, but there was no unknown society or being and there were no data. Nobody did anything about it, and the study lay there, using up man-months in deep philosophical thought. It ran out of man-months and the problem wasn't solved or described. The emphasis in this example is in the importance of recognizing that a problem exists or that a data gap exists and the importance of early recognition and the importance of an early announcement that the problem exists.

Let me take a moment to wrap up the cliff-hanger. The problem has now been defined, the Surgeon General is conducting the study, and, upon completion, the data will be furnished.

#### Define the Problem

Now that it has been recognized that a problem or data gap exists, we become involved with one of the most difficult and, at the same time, one of the most important phases. In my own personal experience, I have seen 16 studies that have run the full gamut from concept to completion without the problem ever having been really defined. All too frequently, the study is well on the road or is completed before anyone asks these questions: Is there a clearly defined need? Is there a real require-

ment? Is there an end product (not necessarily hardware)? Is it limited or is there a statement of what we do with tangential problems as they are uncovered? Is there a well defined scope or content? Are the constraints announced?

The foregoing are the discipline challenges, the questions which must be answered in order that we can properly define the problem. The definition of the problem must be simple even though the problem is complex. In our area of endeavor, however, it isn't a question of my problem or your problem; it's a question of *our* problem.

#### Literature Search

This is our opportunity to find out whether or not someone else has already solved our problem or, possibly, a part of the problem. It also gives us an opportunity to find out who else is interested in our problem and determine who else has the same problem. A ready source of information is the Defense Documentation Center. Also, let me propose an idea: Why not send out "letters of intent" to agencies which we may consider as being interested? That is, we write letters to those headquarters and elements which we believe may have some interest, and we tell them of our intent to pursue a study in an area. We query them regarding their actual or potential interest and ask for advice and assistance and inputs. The replies to these letters of intent may prove most interesting and most exciting. Any study must be a team effort working to a common goal and with the assistance of all interested parties. The addressees may not even know that they have an interest until they examine our letter of intent, search their own requirements, and examine their own.

### Work Program

In the same manner that you need a program in order to know who is playing the game, you need a complete work statement before you really understand what is required. I believe it is important to have a work statement even before the decision is made as to whether or not you desire to request contractual support. The rules here are basic. The work statement must be prepared in accordance with Appendix A to AR 1-110. The work statement is the very foundation and the bible from which the work directive is developed. It must be specific; it must be definitive; it must be explicit; there must be no doubt as to what is required. Let me give you an example of a work statement which did not follow the rules.

"To examine the quasi-orthogonal systems of modulation (QOM) utilizing pseudo-random (PR) coding to provide a tactical system of communication in which the sequence generators or other implementation techniques will provide for combining the now separately implemented functions of uniquely identified and coded subscriber channels, anti-jamming and anti-spook protection, and cryptographic security." And that was it. That is all. Nothing more followed.

### In-house vs. Contractual Support

This is not as difficult as it sounds. As a matter of fact, it is quite simple. Look at your resources. Look at the knowledge, experience, and quality of your resources and determine whether or not you can do it within your existing resources or whether you need additional military and professional Civil Service help. If so, announce what is required and be prepared

to justify the need for each individual.

If you have all the capability except for certain key knowledge, announce what additional knowledge or expertise is required and ask for experts or consultants for short periods of time. You may need some contractual assistance, still doing the job in house. Just be sure that you are not asking for personal services. These personnel must be given an objective which is part of the overall study. If it is determined, after expending all of your effort, that it cannot be done, then ask for a contract.

We are all engaged in developing qualified OR/SA personnel in the Army, and, when we get them, we will be able to do much more in house. However, in my opinion, this will not reduce the amount of money required for contractual support. Those contracts which we do issue will call for greater expertise and fewer drudges on the job. We will not be paying for information muckers, data gatherers, and other lesser included individuals, but we will require, and we will be forced to pay for, higher-quality personnel than we are getting in support now.

### Request for Proposal

The most important thing to remember here is that the request for proposal is prepared by the contracting officer and is based on three inputs:

1. Statement of work; 2. the request for the study; and 3. estimate of funds required.

It is enough at this time to remember that the value of the request for proposal is directly proportionate to the value of the work statement.

### Technical Evaluation Board

This is a board appointed to review and evaluate all contract pro-

posals and make recommendations for selection of contractors. The board will consist of those persons technically best qualified to represent the command, with appropriate consideration given to including representation by the command, institute, group, or agency requesting the contract.

The Technical Evaluation Board receives, reviews, and becomes familiar with all of the contract proposals. All areas involving monies, labor, and costs are deleted from the proposals prior to the submission to the Technical Evaluation Board. This board technically rates the proposals and recommends to the commander, who is the contracting authority, the firm or firms which are best qualified to perform the work under the proposed contract. Deliberations involving money, after the Technical Evaluation Board selects the firm or firms it considers most qualified, is the responsibility of the procurement agency with inputs developed by the Defense Contract Audit Agency.

It is imperative that the chairman of the Technical Evaluation Board be intimately familiar with the operation of the board, the forms used, and the scoring procedures, because, generally speaking, the other members are not. Altogether too few Army officers and professional civilians are familiar with the operation of the evaluation board.

We use a form which involves 10 areas to be evaluated. These areas are divided into technical and administrative. In the technical area there are six evaluation factors. In the administrative area there are four. In the technical area the six are:

1. Response to the statement of work; 2. grasp of the problem; 3. project planning; 4. methods

used in evaluating; 5. technical requirements; and 6. techniques to be used.

In the administrative area the four are: 1. Quality and availability of personnel; 2. experience in similar or related fields; 3. adequacy and location of facilities; and 4. facility and security clearances.

The board, after becoming intimately familiar with all the proposals, first establishes a score for each of the 10 areas. It then establishes a weighting number for each — the weight times the raw score equals the weighted score. The weighted score, divided by the possible maximum score, equals percentage. We have found in our deliberations that the smaller the total possible score, the closer the final percentage relationship of contractors to other contractors; and, conversely, the larger the base, the greater the difference in percentile points among contractors. We therefore recommend the largest possible base within manageable proportions.

The most important point here is that the proposals are evaluated without any consideration for the dollars involved.

Should you find yourself as chairman of one of these boards, beware, be careful that you are able to quickly evaluate the capabilities and qualities of your members. You, in the last analysis, are responsible.

Let me paraphrase Frederick the Great: "There are four types of officers in the Army. There is the lazy and stupid. He makes an excellent stable officer. There is the lazy and brilliant. He makes an outstanding staff officer. There is the ambitious and brilliant. Make him a general (or a GS-16). Then, finally, there is the ambitious and stupid. He's dangerous. Shoot him."

While you can't shoot a member, you can certainly relieve him. Also, based on my personal experience, I have found that at least half the chairman's time on the board is devoted to educating the members of the board.

After the contract has been awarded, any of the other contractors whose proposals were under consideration may request and receive a debrief on why he failed. You must be prepared to present this. It is generally a good idea to work up your briefing jointly with the procurement agency, because he may not have failed based purely on your findings.

I recently sat as chairman of a Technical Evaluation Board in which the request for proposal stated, "The contractor will state whether he has a special intelligence facility, constructed within the provisions of the *ACSI Bulletin*, within 50 miles of Washington; and if not, that he is prepared to construct one within provisions of the *ACSI Bulletin* within 6 months after the award of the contract."

One proposal failed to address this point. This specific item was worth 10 points and the weighting worth 10, which equaled 100. The point score base was 1190. The loss of 100 points out of 1190 caused him to lose the contract.

I told the contractor the truth. I also reminded him that I could not speak with him after the pre-solicitation conference. I am sure that somebody was fired, but it wasn't I.

#### Project Advisory Group

As a minimum, each contractually supported study should have a Project Advisory Group. This group is charged with a mission of providing overall monitorship of the study for which they are responsi-

ble and for providing managerial liaison between the customer and the contractor. The objective is to insure that the contractual support is developed under the proper terms of reference and that it responds to the contract directives.

The Project Advisory Group provides advice to the customer and assures that the contractor responds to the customer's direction on all matters pertaining to the performance of the contract.

To insure high-quality implementation, each agency having an interest in the contract should provide a member on the project advisory group. Each commander providing a member should assure himself that the member has knowledge in the subject area, that he can and will be made available for all meetings, that he is prepared to enter into discussions at each meeting; and that there is continuity on the job.

It is important to note that Project Advisory Group duties are not extracurricular but are a part of the assigned duties of every member. It is imperative that the member keep himself abreast of the project progress and that he attend each meeting, prepared to contribute to the project in a meaningful manner.

It is incumbent upon the customer's representative who is chairman of the Project Advisory Group, to provide each member with a detailed agenda and a list of problems which are to be discussed or which require resolution. This agenda must be furnished in sufficient time so that the member can familiarize himself with the problems and subject matter, do his homework, and be prepared to provide meaningful comments.

Should you find yourself in the position of being the chairman of a Project Advisory Group, you are

directly responsive to the commander; the members of the Project Advisory Group are directly responsive to you. The Project Advisory Group is one of the most important management tools that the commander has. It is his eyes, ears, heart, and pulse.

The Project Advisory Group is to studies as IPR's are to hardware studies. In order to be sure that we are all singing from the same sheet of music, let me give you the definition of an IPR (In-process Review) from AR 705-5. "A review of a materiel development project conducted at critical points in the development cycle for the purpose of evaluating the status of the project, accomplishing effective coordination and facilitating proper and timely decisions bearing on the future course of the project." To the best of my knowledge, there is no definition for a Project Advisory Group, so I will quote from CDC Regulation 71-6: "A steering committee consisting of selected personnel from elements having command or staff interest in the problem being investigated by the project contractor for the purpose of adding depth and breadth to the evaluation and guidance of contractor performance."

The best document that I know of to describe the Project Advisory Group and its duties is an OCRD document entitled The Project Advisory Group and Its Duties, dated January 1969.

### Managing the Project

What follows is a personal position. It has worked. Contractors are extremely interested in it. It's what we call the plateau system. As soon as the contract is awarded, we begin work with the contractor in the "insurance" program. That is, to be sure that both the contractor and the customer understand

what is wanted. The customer prepares the requirement in relative isolation. The contractor prepares his proposal in isolation. Now these two isolated groups must be brought together to sit down in personal confrontation, analyze the work statement sentence by sentence, paragraph by paragraph, and develop a memorandum of understanding to be sure that each understands the other and that there are no unanswered questions as the work gets under way. This is the first plateau. At this point, we stop and brief the memorandum of understanding to all the members of the Project Advisory Group. This discussion may result in some changes, within the terms of the contract, and be included into the memorandum of understanding. After everyone is satisfied, we then move on to the second plateau.

Plateau 2: we take a hard look at the contractor's known requirements for literature and data and match against these requirements what we have accumulated, thus developing the shortfall. We, the customer, go out on the search, gathering the additional literature or data or at least announcing what remains in shortfall and what must be done about it. We then proceed to plateau 3, the management of the contract. We hold Project Advisory Group meetings as required but not less frequently than quarterly. At the call of the Chairman of the Project Advisory Group, subcommittees may be organized to work on various facets. We critique the contractor's work as it progresses. We do not wait until the end of the contract to determine that many months ago an error was made. We know and understand the mathematics, the formulae, the procedures, the models, the data. As each significant plateau point is reached, we have

a meeting and we agree or disagree, we modify or change or accept, as the case may be, but we do not proceed to the next plateau until such time as the customer and the contractor are satisfied. In this way, we know well in advance the difference between estimated expenditures and actual expenditures in terms of personnel and dollars; we know whether or not we are on schedule; and we can anticipate problems before they arise. Every study must have a sequence-of-events chart. This is the timetable.

### Implementation

Most studies, upon completion, are published in initial draft, then sent to the field for comments. The comments are incorporated and then it is published in final draft; then comments are received, these are incorporated, the study is finally published, and that is the end of it. But it is not the end. It is a new beginning, the beginning of the implementation of what we have learned. It is important that at least one of the customer's representatives and one of the contractor's representatives remain

active to assist in the implementation of the study results; to assist in the formulation of doctrine, development of organizations, and the preparation of materiel documents. These points should be considered when preparing the request for contract and when considering the final recommendations. Now we have made the full cycle from concept to implementation.

We believe that we have an exciting program. We further believe that some parts of this program may be useful to others. My purpose in making these comments is not to tear down anyone or anything, nor state that one command or one element is doing a better job than another; nor do I attempt to grind a personal or professional axe. My primary purpose is to pass on information and to challenge your imagination and to assist you in periodically asking yourself the question, Can I pass the test?

The question really is, Are you going to be journeymen?; if so, will you apply for a grade reduction or will you be managers? Can you pass the test?

## OR/SA IN AN INDUSTRIAL VS. MILITARY CONTEXT

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I would first like to say a little about the line-staff relations in industry as contrasted to the military, since this affects the manner of use and implementation of OR/SA studies. While the military establishment has rather clear-cut distinctions between command and staff functions, industry often draws no such line. It is not at all unusual in industry to have the top executives of a company responsible for both some line functions and some staff functions, based on what may sometimes appear to be rather arbitrary criteria. For example, the chief executive officer of a company may choose to delegate all line operations and staff functions to specific individuals, or he may choose to retain direct line supervision of one or more line operations and staff functions himself. The closest military parallel is the division engineer in a line combat division; he is both a staff officer and commanding officer of the division's engineer battalion. Some companies endorse the principle of staffs at every level, while others permit formal staffs only at the corporate level. I suppose there are even companies which persuade themselves that they have done away with the staff concept entirely, whereas in actual fact they

simply assign staff work to operating components.

These differences in organizational concepts affect studies of the OR/SA type. Studies may be performed by staff elements entirely, by operating people temporarily appointed to *ad hoc* working groups, or by a combination of staff and line people. Using appropriate staff people, particularly from corporate staff, enhances expertise, while using operating people from the component concerned increases involvement and makes information gathering easier.

In any case, the study group generally has to sell its recommendations to the operating component general manager, since the profit or loss responsibility is his. Naturally, the general manager is apt to be more receptive to the study recommendations if he or one of his next lower line subordinates asked for the study rather than if the study was directed from above him. In some companies, the corporate staff has the right to look anywhere within the company and initiate studies on its own where it feels necessary. However, corporate staffs usually find that it is preferable to persuade the operating component to ask for help and to then participate in the study.

Now I'd like to discuss operations research/systems analysis applications in industry. One important difference between industry and the military is the criteria they use — profit (net income or return on investment), rather than effectiveness/cost.

But there is another important difference. In military studies, one can either examine the relative cost of achieving a given effectiveness by various alternative means, or else determine which level of effectiveness a given amount of resources will produce under various alternatives. In other words, one can make either the input or the output of one's model the independent variable. Industrial studies do not often use the latter approach; they normally use the former (an established output level, various alternative inputs). The reason is that market analysis usually establishes a required level of performance, and thus fixes the desired output volume and price.

A third difference, which applies even in military equipment contracted out to industry, is that industry deals with performance specifications rather than with actual effectiveness. The effectiveness of a weapons system or communication system is affected by a number of environmental and mode-of-use variables. These are, of course, important to military commanders, analysts, and logisticians, but are rather difficult to incorporate into specifications. I do not believe it is feasible to write performance specifications in such a way that they will guarantee the level of effectiveness desired by the military, unless industry is in effect given a contract to operate the system under specified conditions as well as to build it. In saying this, I am not making a case for or against such a procedure, but only pointing out that when you buy hardware to operate yourselves, particularly under the uncertainties



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Dr. Kellogg was the first director of the Army Management School's Department of OR/SA in the period 1967-68. He retired in the grade of colonel in July 1968 to accept his present position.

(This article was adapted from Dr. Kellogg's address before the Operations Research/Systems Analysis Executive Course at USAMS on 28 Feb. 1969.)



of combat conditions, its effectiveness is necessarily your responsibility. Proper prediction of the relationship between performance specifications and field effectiveness should therefore be one of the military analyst's major concerns.

While both industry and military are concerned with the speed of pay-off of a given alternative with respect to the investment required, there is a difference in viewpoint and criteria. The military tends to use the discounted present value of the investment for comparative purposes, while industry prefers to use the "cash flow" concept: How many cumulative dollars will we be in the red at the deepest part of the investment curve? and how long until the project is back up in the black? This difference of viewpoint is understandable, since industry has to pay or at least charge itself for the use of funds which could have otherwise been used in other profit-seeking ventures, while the military does not (unless one has the view that there is an acceptable and quantifiable alternative to the maintaining of a defense establishment).

Now I would like to turn to specific OR/SA applications in industry. Before discussing two specific applications of interest, I propose to give my subjective opinion on the relative amount of utilization of various OR/SA techniques in industry. Modeling and simulation techniques are used quite extensively. The use of probabilistic analysis is increasing, particularly since widespread use of computer time sharing entered the picture. Production control, inventory control, and process control models are being used more and more. The input-output model has had a few notable applications, but is still too expensive in time and money for all but

the largest companies, or those of a specialized nature whose variables are readily determined. Linear programming seems to be used surprisingly little, probably because truly linear situations are rare in real life. Queueing theory is not often found outside the communications industry, and sequencing theory has the same drawback as linear programming, namely, real life problems have too many non-linear factors. I have heard it said that sometimes a sequencing model can come close to being almost as good as an experienced factory scheduler or foreman in allocating and sequencing production jobs, which these men do in a few minutes on a scratch pad, or even in their heads, without benefit of computers or recorded data banks. The reason, of course, is that these men take subconscious note of human factors plus small machine/process idiosyncracies that are too complex or too tedious to quantify for the computer. However, for a brand new scheduler, sequencing theory might do better.

Dynamic programming applications are beginning to appear, but as you know, this is a tricky technique to apply in spite of its inherent power. There is some use of Boolean algebra in the study of equivalent circuits. Decision theory has come into fairly wide use, but game theory has not done as well. It is possible that the very name "theory of games" raises suspicion among those who have to account to stockholders.

Companies have a growing library of proprietary and leased problem-solving computer programs which they can use. The existence of these libraries makes practical the attack by OR/SA methods on a number of problems which would otherwise be too expensive in time and money to warrant a study,

particularly in a profit-seeking climate. One specific example is a sophisticated program for probabilistic analysis. Normally, probabilistic analysis of a model would require a competent computer programmer and appreciable time, or else a good deal more of laborious hand computation. But it has been found feasible to write a time-sharing program into which a person who is not even an amateur programmer can insert his data and equations and execute probabilistic analysis of any variable he chooses, with a choice of several probability distributions. The entire process can be done in a matter of minutes, including data input and output printouts such as tables and/or histograms.

Program network analysis, in the form of PERT, is, of course, often used by industry on military work because it is required by the terms of military contracts. Industry has sometimes found the PERT-time technique of sufficient value to use on non-military programs, but voluntary PERT-cost applications are rare. One interesting auxiliary use of PERT has been to determine the requirements for skilled engineering manpower for activities coinciding in time. In at least one case, this factor, rather than funds or equipment, turned out to be the limiting one.

Statistical analysis and sampling theory have been used in industry for a long time, although experiment-design theory has not been extensively used in industrial plants outside of laboratories. Regression analysis is misused about as much as it is anywhere else.

Now I shall turn to the kinds of specific problems for which industry uses OR/SA techniques.

First in glamor is the total-business model. There is a great

variety of such models, ranging from simple one-line equations to complex input-output models, with feedback loops, able to handle hundreds of variables. There are business games, similar to war games, which permit a test of business strategies against a programmed or live competitor-player.

A second application, perhaps less glamorous but more important, is the use of systems analysis for military and civilian customers, both by contractors and by independent analyst-consultants.

A third application is the use of models of processes, which I plan to discuss later.

A fourth is the use of models for establishing the relative priority or predicted merit of advance engineering projects, considering both technological and business factors and involving subjective variables.

A fifth is the use of product structuring models, to establish the most economical use of the minimum number of components and product models to satisfy the maximum number of customer requirements. This model can be combined with a business and market forecast model to predict the optimum composition of a product line for maximum theoretical profit. A military parallel of this model would be one to establish the minimum number of truck models with the maximum of common components to perform missions in a number of environments and tactical situations.

The product structuring model can be expanded from a decision-making study to a continuously-used automatic order and scheduling system. This can be in the form of files of definitive designs to be selected from, or it can be a regenerative redesign of the product based on each new incoming order within specified limits, to

meet the customer's requirements in the most economical fashion. The really sophisticated part of such a process is the balancing-off of the direct material and direct labor costs of many individually economical designs versus the indirect costs and savings of volume production of a smaller number of individually less economical designs. In other words, should you give a customer more than he needs, in order to obtain the economies of scale inherent in large-volume production of the next-higher-rating model?

Now I plan to discuss two examples of OR techniques used in industry. The first is a process study, used in industries which have a sequenced set of operating processes with varying yields (fractions which pass inspection) at each station, and also feedback loops of quick or long reworks of those products which do not attain the desired status. Typical examples are a petroleum refinery

and a color-television picture-tube production line. I shall use the latter example to describe the OR process-control model and its application.

First, one flow-charts the production line to show the sequence and direction of work-piece flow on the main production line (Fig. 1). There are nine major stations, starting with preparation of the glass surface and applying the green phosphor, and ending with application of the implosion-protection banding. While there are several steps at some of the stations, they are of such nature that inspection/rejection is only feasible at the completion of the nine major operations. These major operations are named as follows:

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 1. Green phosphor application   | 5. Funnel to tube assembly and baking |
| Blue phosphor application       | 6. Electron-gun attachment            |
| 3. Red phosphor application     | 7. Bake-out and exhaust               |
| 4. Aluminum backing application | 8. Picture pattern test               |
|                                 | 9. Implosion banding                  |

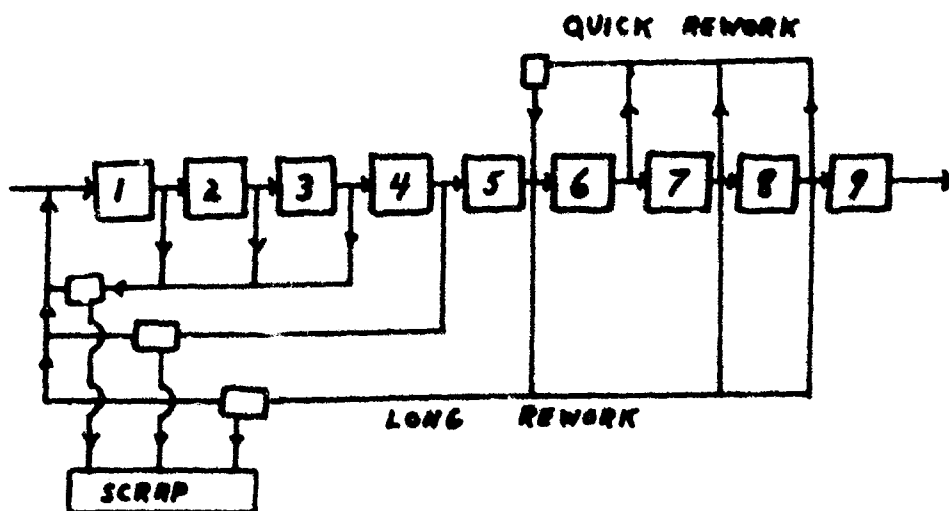


Figure 1. Process yield model.

As the flow chart shows, certain rejects at some of these stations need only be recycled through the same station, others go back a couple of steps, and still others have to go through salvage operations for disassembly and then start back at the beginning. The next step is to establish the costs at each station — unit costs of each material used, hourly labor costs, equipment operation and maintenance costs, and a properly allocated portion of all the variable and fixed costs which the whole factory incurs. One also needs to determine the production capacity per hour, yield, fraction of quick and long reworks at each station, plus the cost of reworks, salvage operations, breakage losses, and value of salvaged components. A mathematical model of the flow-diagram is prepared in a computer program, and the input variables I have mentioned are inserted. The input data for such a single product line consists of an 18 x 9 matrix, which takes about five minutes to put into the computer manually on a time-sharing terminal. The program takes several days to write, but of course it can then be re-used indefinitely. The computer program can then be run to find the following information: predicted annual production at each station; average cost per tube at the completion of each station; total profit per year; breakout of prime costs, period costs, labor, materials, losses, salvage.

The printout also shows whether the line is "balanced" or not, i.e., whether any station is being forced to limit production because a succeeding station cannot handle the volume. Naturally, you would like to design your plant and equipment for a perfectly balanced production line. But this could only be done by guessing your yields perfectly —

in advance. And then you still get unbalance if you improve the yields unevenly.

The model is used by first inserting actual data and verifying that the model gives the right answers for verifiable outputs, such as final production volume. Then one can start adjusting various inputs to see what can be done to improve volume and profit — increasing capacity at bottleneck stations, improving yields, reducing reworks and losses, etc. Naturally, these must be limited to plausible actions. For example, a queue before final test is permissible and in fact desirable (to detect slow leakers), but a queue is not desirable between stages of phosphor application (dust and dirt accumulation) and is not permissible just before one baking operation. One cannot make much change in a baking operation; the one big oven has to run as long as there is any production at all, and adding a person won't change its capacity. Implosion banding, on the other hand, is a very flexible operation. It can be postponed, and one can increase the capacity practically without limit by adding people, since it requires little equipment and uses relatively unskilled labor.

Thus one can model all sorts of adjustments to the line and predict the cost, output, and profit before trying it out on the actual line. For example, by using a sensitivity analysis option in the program, one finds that it pays off much more to increase the yield at some stations rather than at others. The model also predicts what will happen if you should choose to buy partly fabricated tubes and insert them into the production line after station 4.

There are, of course, certain precautions necessary in using this model. As I mentioned, one must

first calibrate it with real data to be sure it represents the actual situation adequately. And if one continues to use it, the input data must be updated periodically and again the results must be compared with reality. A military equivalent of the process yield model is an officer candidate school, which has fairly high attrition rates and uses both quick and long recycling.

So much for the process yield model. Now I would like to take up the indirect cost model. Indirect costs are important because they constitute up to half of the total cost of a product. They are defined as the cost of everything except the direct labor and direct material going into the product. While every manufacturer documents and analyzes his direct costs, indirect costs are often simply aggregated into variable and fixed categories and then allocated to product costs by fairly crude rules of thumb. This means that many manufacturers do not really know what actual indirect cost they incur as the result of doing or changing a given procedure.

The basic problem is that indirect costs are normally charged to organizations rather than to the meaningful activities which members of the organization perform. The indirect cost model flow-charts the business into its essential activities, connected by parameters. Parameters are defined as a measure of activities; for example, the activity "materials procurement" is measured by the parameter "number of purchase orders." In the process of flow-charting, one finds that the flows are sometimes purely linear, but sometimes branch or make loops. These branchings and loops represent alternative procedures, and imply a choice between procedures whose costs are different. To

flesh out the model, one obtains numerical values of parameter volumes and reallocates the dollars spent by organizations to the activities measured by the corresponding parameters. One then calculates the average unit cost of each parameter by dividing the activity cost by parameter volume. Properly displayed, this data permits analysis of alternatives at the lowest level. One can also combine the data into more complex "test questions" to calculate the total average indirect cost of a set of actions. For example, one can calculate the indirect costs of making 10 units one at a time versus batching them. A key point is that the procedure displays the "chain reaction effect" downstream on indirect manufacturing costs of a seemingly inexpensive decision made in engineering or marketing.

The procedure can be and has been computerized to reduce the amount of calculation required. However, the data gathering required is not insignificant, particularly the first time. Flow-charting, interviewing, analysis, and execution of the procedure normally take about six man-months of effort the first time. Repeat runs at annual intervals to measure progress in improvements should take only two to four man-weeks. The reductions in indirect costs can be of the order of 10%.

I believe such a technique could be of value for military installations. For example, besides military manufacturing-type installations such as shipyards and arsenals, even a pure troop-training installation could profitably use the technique. The salaries of trainees and of the cadre actually doing the training are your "direct labor"; the cost of trainee rations and training ammunition are your "direct materials." Everything else,

from the base commander's salary to the cleaning materials used on barracks floors, falls into the category of "indirect costs." On this basis, your indirect costs are probably even higher than industry's, and therefore warrant attention.

As I mentioned earlier, such studies do take considerable effort, particularly the first time. Computerization helps, but also involves effort and money. Therefore, such efforts should only be undertaken if the procedure evolved can be and will be applied repeatedly, for a number of organizations and in successive time periods. This criterion of repetitive use also applies to studies in general, of all the types you are concerned with. Do not spend time building an elaborate model for one-shot use. The model described by one of your speakers for re-allocation of radio frequencies would not be justifiable on economic grounds if it were not applicable repeatedly. If I may venture a personal opinion, I believe that the military services generally take too long on their studies. Industry seems to be able to execute its own routine studies in about six months, and to create reasonable models for them in days to weeks, whereas it has been my experience that similar military-sponsored efforts take about twice as long, whether they are done in-house or on contract. I will concede that a portion of this extra time is probably due to the fiscal-year concept that is imposed on military projects by the nature of the Federal budget process, and that the concept of a program definition phase before starting work also adds time. I realize that these factors are probably beyond your control, but I do bring the matter up in the hope that none of you will assume that a full year constitutes good progress for

the average run-of-the-mill study from start to first definitive results.

Another disturbing tendency I note, in both industry and the military, is continued reliance on obsolete data. Someone creates a good model, obtains the best current data he can, and then pursues more and more refined analysis while his data becomes more and more out of touch with reality, through aging. Specifically, price data a year old could easily lead to an incorrect choice among alternatives. A reasonable rule of thumb is to strive for not over 10% error in data, and test your model for its sensitivity to a 10% variation in each data element. If you find any element whose effect is so non-linear that it radically changes your result, you should either give special attention to the accuracy of the corresponding data or else introduce probabilistic analysis for that element.

As my final point, I shall say something about the problem of centralization versus decentralization of decisions, and the related time factors. This problem occurs in all large organizations, civilian as well as military. My thesis is that there are tradeoffs to make in the very decision as to what organizational level to vest with given decisions. Centralizing decisions at higher levels increases coordination and the degree of optimization, but is slower; decentralizing them downward is faster, but degrades the degree of optimization attainable. Industry offers a specific situation which illustrates the point. Many large companies make their subdivisions fairly autonomous profit centers, even when they supply each other with certain product components. The transfer of these components must be priced. If the components are also sold to outside customers, or can be purchased on the open market, there is little

problem in establishing the transfer price. But if there are no outside suppliers or customers, the problem of establishing an optimum price is more difficult. The selling department wants a high price, the buying department wants a low one. There is theoretically a price which will maximize the profit of the total company under any particular conditions. But because conditions do change, the company as often as not delegates the price decision to a negotiation between buying and selling departments. Unless the negotiation happens to establish the above-mentioned optimum price, the company's overall profits will be lower. Nevertheless, the pressure of time and change may force adoption of a sub-optimal price policy.

I brought up this point because it also applies to studies. I personally believe that the military establishment overdoes optimization at the cost of time, and often uses up a good portion of the viable life cycle of a weapons system in extended studies. As I have said, I recognize that a major portion of this delay is forced on you gentlemen by factors beyond your control, but I ask you again to at least not aid and abet the situation by agreeing that long studies are desirable.

I tried a little personal research on this matter of establishing what ratios do exist or should exist between study, decision, and execution time for projects. By examining projects of varying magnitudes, I came to the conclusion that the ratio of decision effort to study effort to execution effort is about 1:1:1 around the \$10 level, and rises to 1:1000:1,000,000 at the gross national product level. If this conclusion is correct, it says that we can plausibly spend 1% or more of our effort on study of projects up to the level of millions of dollars,

but that time and skilled manpower resources simply run out on us when it comes to higher dollar-level programs. The lesson I draw from this is that we might as well recognize and admit the overriding importance of the time factor in problem-solving, and be prepared to accept the forced tradeoff in sub-optimization.

As a case in point, let me refer to the great social pressures which exist for the optimization of environmental control (air and water pollution control, etc.) as well as of technological advance. There is a danger that if we try to over-optimize, we can seriously hamper our very attempts at solution, simply because well-intentioned people do not appreciate the time-constraint problem I have outlined. The process of political agreement is slow and the requisite studies are even slower.

Now, I am not advocating that anyone insist on having an accurate total-ecology-balance model of the world prepared in six months' time; but, on the other hand, I do think that several years is too long to study something like adoption or rejection of a particular commercially-available weapon, as has happened.

I will close by lauding one man in ancient history who really understood the importance of time — Alexander the Great. His battles were marvels of tactical timing, in spite of the primitive communications of that day. It is told that, before battle, he would call together his subordinates and have an orderly tie a freshly wetted strip of cloth around the left arm of each. He would then order them to ride to their battle stations and launch their attacks the instant that the

last trace of moisture disappeared, insuring a simultaneous, coordinated action. And this, gentlemen,

is the origin of that well-known expression, "Alexander's ragtime band."



# MATHEMATICAL PROGRAMMING APPLICATION TO FREQUENCY MANAGEMENT

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**I**t is indeed a pleasure to come once again to the Army Management School to talk to you about applying operations research techniques to radio frequency management problems. The RAC frequency management study is sponsored by the Department of the Army, Office of the Assistant Chief of Staff for Communications-Electronics. Since 1964 we have been working to develop improved procedures for assigning tactical frequencies and call signs to the HF and VHF FM radios within a field army.

The objective of the study is to develop improved procedures in order to obtain increases in the number of usable frequencies, improve compatibility, and make assignments faster.

We have developed a family of procedures, three for field army level and three for division level. (See Figure 1.) The first, shown for field army level, is the FM List Generation Procedure. The objective of this procedure is to produce the lists or blocks of frequencies at field army level for assignment to the major subordinate commands such as divisions, corps, cav units, and so forth. In generating these lists of frequencies, it solves two problems: the host country restriction problem and the compatibility

problem. The host country restriction problem manifests itself by restricting certain frequencies, that are generally available to the field army commander, from use in certain geographic zones located throughout his area. In solving the compatibility problem, we want to place frequencies in the list which will work in close proximity with each other to the maximum extent possible. The output of the procedure is the Communications Electronic Operations Instruction (CEOI). The procedure in its automated form requires about 1-hour set-up time and 30 minutes of run time. This compares with some 2 weeks to do the job manually.

The second procedure, the HF Assignment Procedure, assigns HF frequencies (i.e., 2-30 MHz) to nets and solves the ground wave and sky wave propagation problem. It makes assignments that are predicted to work on the basis of propagation. The output is the Communications Electronic Operations Instructions. The automated version requires approximately 4 hours to solve a field-army-level problem.

The Call Word Derivation Procedure derives call words from call signs. It takes the call signs from ACP 110 and looks up the associated call word from the call word

square in ACP 119. The output of the procedure is in listing, tape, or card form. For a field-army-level problem containing some 20,000 call signs, the procedure can look up the associated call words in 33 minutes. This compares to some 220 hours by means of the manual method.

The Call Word Derivation Procedure is used again at division level. A typical division level look-up problem is approximately 10 blocks or 1,000 call words. The automated procedure can do this task in 2 minutes. This compares with approximately 11 hours with the manual method.

The FM List Generation, HF Assignment Procedure, and Call Word Derivation Procedure are programmed for the Control Data Corporation 3300 computer. Because that

computer is not available at division level, we have developed an SOI Generation Procedure for interim use for preparing the Signal Operations Instructions (SOI). This procedure eliminates the typing problem. It produces the SOI formats and automatically derives suffixes guaranteed to be different than the previously assigned suffixes. The comparative speed of the SOI Generation Procedure is 3 hours vs. 30 hours or a factor of 10 to 1. This procedure is designed for the UNIVAC 1005 4K computer or card processor which is available in all U. S. divisions.

We are in the process of developing the Unit FM Assignment Procedure, which will ultimately replace both the SOI Generation and the Call Word Derivation at division level. This procedure is being pro-



**MR. JAMES E. RUSSELL**

Mr. Russell received his B.S. in Electrical Engineering from the University of Idaho and completed the course requirements for his M.A. in Statistics at the American University.

In 1956-57 he was a staff member with RCA, where he did research in design, testing, quality control, standardizing, and automatic application. Among the Government projects which he participated in in the period 1957-60 were those on circuit analysis, radar, and missile guidance.

He has been with the Research Analysis Corporation since 1960 as project chairman on studies in communications, electronic warfare, and frequency management.

(This article was adapted from Mr. Russell's presentation before the Operations Research/Systems Analysis Executive Course at USAMS on 6 Oct. 1969.)

Family of FM and HF Assignment Procedures

FIELD ARMY LEVEL			
	FM List Generation	HF Assignment	Call Word Deriv
Produces	Lists Management Aids	Net Assignments Management Aids	Call Signs Call Words
Solves	Restriction Compatibility	Ground Wave Sky Wave	Look-up
Output	CEOI	CEOI	Listing, Tape, Card
Comparative Speed	1.5 hrs vs 2 weeks	4 hrs vs ?	33 min vs 220 hrs (supp)

DIVISION LEVEL			
	SOI Generation	Unit FM Assignment	Call Word Deriv
Produces	Formats, Suffixes Management Aids	Net Assignments Management Aids	Call Signs Call Words
Solves	Typing	Reuse, Compatibility Restriction	Look-up
Output	SOI	SOI	Listing, Tape, Cards
Comparative Speed	3 hrs vs 30 hrs		2 min vs 2 hrs

Figure 1.

FM Frequency Lists Sample Output

EFFECTIVE 01 OCTOBER 1967  
SUPERCEDES ANNEX B-1 TO SOI ITEM 3C-14, DATED, 01 JULY 1967

LIST NO. 1

30.45	30.70	30.90	31.00	31.10	31.20	31.35
31.50	31.60	31.75	31.90	32.10	32.20	32.30
32.45	32.65	32.75	32.95	33.80	36.60	36.80
37.35	37.55	37.70	38.25	39.90	40.05	40.25
40.35	40.45	40.60	40.90	42.10	42.15	42.20
42.25	42.30	42.35	44.05	44.10	44.15	44.20

LIST NO. 2

30.35	30.50	30.60	31.15	31.25	31.40	31.55
-------	-------	-------	-------	-------	-------	-------

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Figure 2.

grammed for the Control Data 3300 computer. It takes the blocks of frequencies produced by the FM List Generation and assigns frequencies to nets at the division level. It solves such problems as the re-use problem, the compatibility problem, and the restriction problem at division level. It considers such factors as power blocks and tuning limits of the various radios comprising the nets in making these assignments. The output of the procedure is the SOI.

All of the procedures except the Unit FM Assignment Procedure are complete. This procedure will be completed by June 1970. Eight methodology and user's manuals have been written and supplied to the Army for review and interim use. Final publications will become available in 1970.

Today I am going to discuss only the FM List Generation Procedure. It may be viewed as a frequency management information system designed to assist a frequency manager in getting the most effective use out of his limited frequency resources. The procedure provides the necessary information and data to permit management decision.

The FM List Generation Procedure produces lists of frequencies. Where frequencies in the list should have two characteristics: (1) they should not be restricted in the areas of operation of the units to which the list is assigned, and (2) the frequencies should be compatible with each other. That is to say that they should be able to operate in close proximity with each other without causing interference. (See Figure 2.)

The host country restriction problem for Seventh Army is shown in Figure 3. Here we see some 30 geographic zones represented by the circles and rectangles on this over-

lay of the map of West Germany. There are 5 deployed unit boundaries shown on the overlay. The problem in generating lists of frequencies for these units is to (1) consider the restrictions which pertain to the frequencies, (2) consider which restrictions pertain to the units, and (3) then place frequencies in the list that are not restricted in the areas of operation of the units to receive the list. The problem may be stated as follows: to take approximately 620 frequencies of which some 540 are restricted in one or more areas, assign them to 10 lists which are going to 25 major units which are operating in 30 restricted zones, and solve this problem rapidly so as to minimize the effect of the local restrictions.

In solving this problem, we used a formulation of the classic transportation problem. In the classic transportation problem, there are a number of warehouses located throughout a country. There is a requirement to ship certain quantities of goods from these warehouses to certain destinations, as shown in Figure 4. The quantity of goods to be shipped to each destination is shown by the height of the bar on the chart. There is a certain unit of cost associated with shipping the unit of goods from each warehouse to each destination. There is a linear programming solution to this problem such that, if you specify the cost associated with shipping a unit of goods from each warehouse to each destination and you also specify the quantity of goods available in each warehouse and the quantity required at each destination, the linear program will solve for the proper quantity of goods to be taken from each warehouse and sent to each destination in order to minimize the total overall cost.

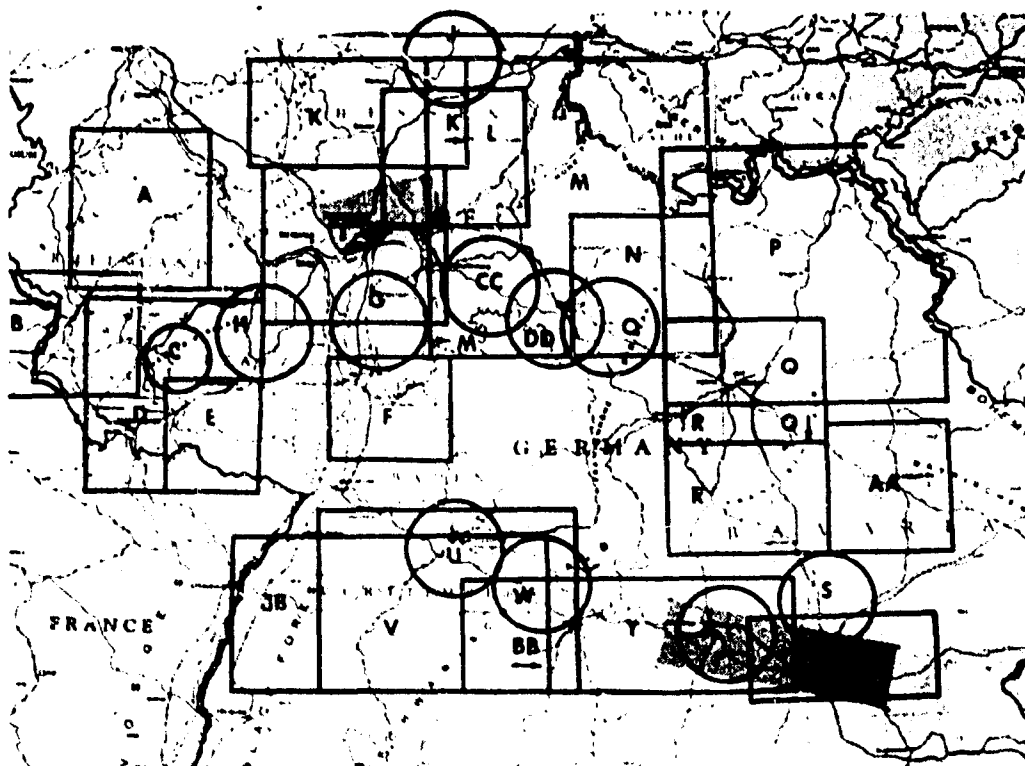


Figure 3.

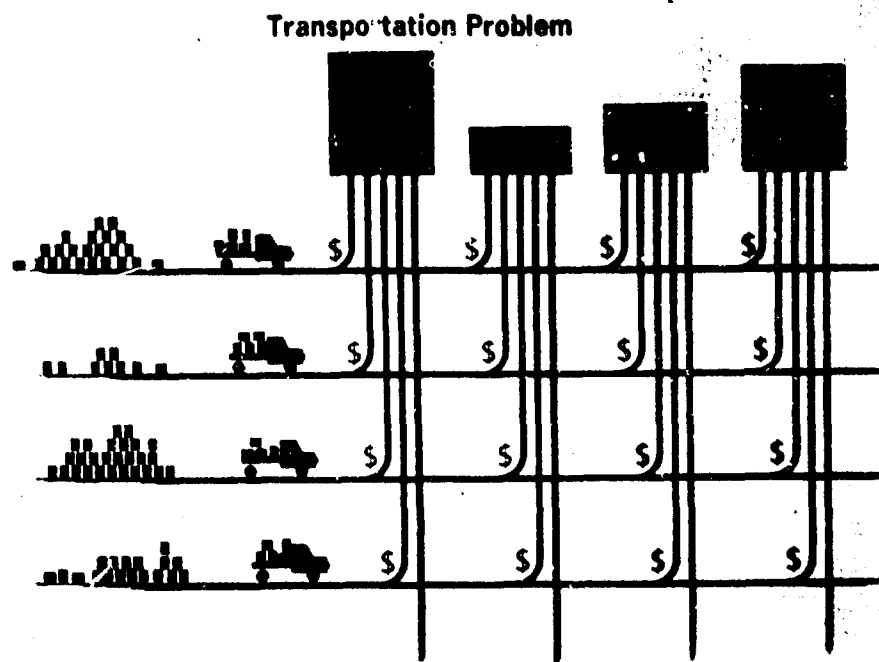


Figure 4.

In solving the frequency problem, we related warehouses to frequency groupings; and we related lists to the destinations. The frequency group is defined to be a set of frequencies which are homogeneous with respect to restrictions. That is, all frequencies in a group have an identical set of restrictions associated with them; so they are equivalent with respect to restrictions. The lists are associated with certain units to which they are to be assigned. We know the restrictions which pertain to the units, and we know the restrictions which pertain to the frequency groupings. The frequency manager assigns a penalty number to each applicable unit restriction based on his judgment as to the undesirability of assigning a frequency, subject to that restriction, to the unit. This number is typically a number between 1 and 10. If a restricted zone overlaps nearly all of the unit's area, he will put a high cost number in, such as 10. If a restricted zone overlaps only a small corner of his unit, he may put in a small number, such as 1. If a restriction does not overlap his unit at all, then the cost is 0. The linear program will assign frequencies from the groups to lists so as to minimize the total overall cost. It will first look for zero cost and then will place frequencies in lists so as to minimize any cost if it cannot find a zero cost solution. The output indicates the proper quantity of frequencies to be taken from each frequency group and assigned to each list.

The specific frequencies that are selected are determined by means of compatibility rules. We had to generate compatibility criteria for the frequencies. The retransmission interference charts, which are found in the back of the Technical Manuals, were all that were available. (See Figure 5.) We quantized

the retransmission interference charts by indicating the relationship between all pairs of frequencies for the FM family. We used seven relative levels of interference, as shown in Figure 6. In the matrix, a 0 in the cell indicates for a pair of frequencies that these frequencies are compatible and may operate in cosite or collocation. A 6 indicates an adjacent channel, a 5 indicates a second adjacent channel, and a 4 indicates a third adjacent channel. The 1, 2, and 3 indicate increasing levels of cosite incompatibility. We then quantized the entire  $920 \times 920$  matrix, and we actually worked with only the lower half cut by the diagonal. Figure 7 is a sample of the cosite interference matrix. For example, 45.95 and 60.20 are compatible and they have a 0 in their cell of the matrix.

The input to the List Generation Procedure is quite simple. The three main types are: frequency, list, and unit. A deck of frequency cards are required — one frequency per card with the associated restrictions that pertain to that frequency indicated. Next, a deck of list cards — one card for each list. For example, list three is to receive 75 frequencies and is assigned to unit 9 and 10. A deck of unit cards is required. If there are 25 units, 25 cards are required. For example, unit 2 is operating in these restricted zones: H, D, I, C and E; and the numbers preceding the letters are the weights placed there by the assigner and are his subjective judgments as to the undesirability of placing frequencies restricted by those letters in unit 2's list.

The procedure produces two evaluation printouts. The first is a compatibility evaluation called SLICOP. (See Figure 8.) This consists of a list of frequencies. Each frequency is compared against all

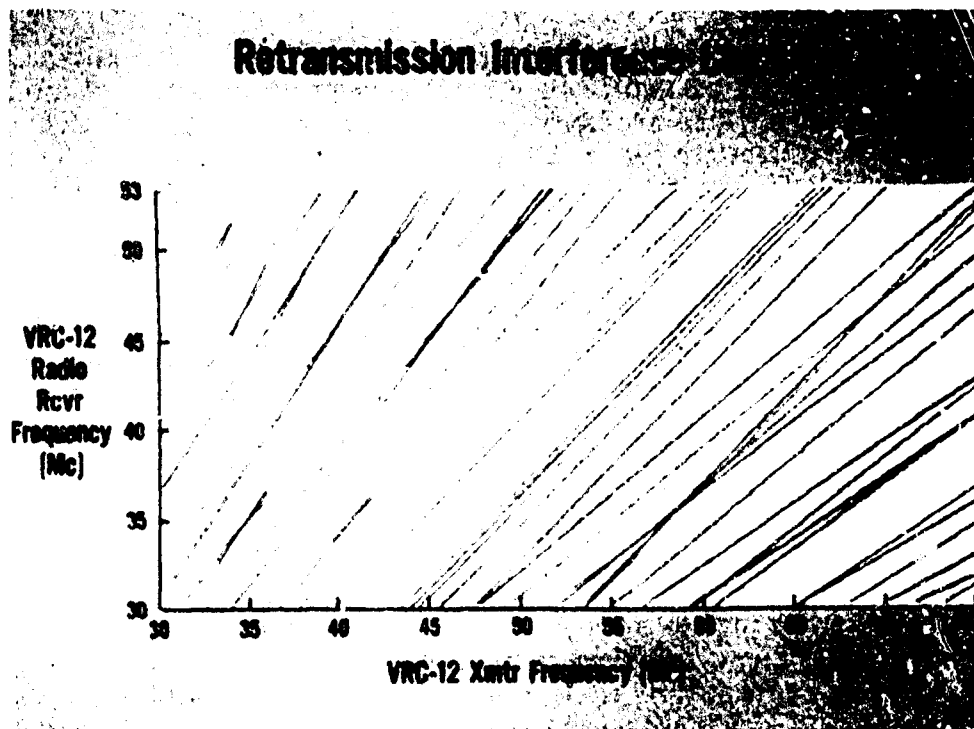


Figure 5.

### Interference Levels I

I Level	Intelligibility of Communications
0	Generally possible
1	Generally possible •
2	Sometimes impossible
3	Generally impossible
4	Generally impossible •
5	Generally impossible ►
6	Generally impossible ►

Notes:

- high noise level
- 3rd adjacent channel
- 2nd adjacent channel
- adjacent channel

Figure 6.

	Freq.			
	60.20	60.25	60.30	60.35
45.95	0	0	3	3
45.90	0	3	3	3
45.85	3	3	3	3
45.80	3	3	3	0

Figure 7.

**SLICOP**  
(Quantity Evaluation)

FREQ	GOODNESS	I VALUE COUNTS						
		0	1	2	3	4	5	6
3005	145	28	3	8	6	0	0	0
3135	152	31	2	5	7	0	0	0
3260	141	26	5	8	6	0	0	0
3385	125	23	3	13	6	0	0	0
Total 46		1066	200	406	396	2	0	0

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Figure 8.



others in the list, and the number of 0's, 1's, 2's, 3's, 4's, 5's, and 6's are counted. For example, 3005 is compatible with 28 other frequencies in this list of 48. It has no adjacent, second, or third adjacent channels; and it has these associated levels of incompatibility, as shown under the 1, 2, and 3. With this evaluation, the assigner can see the quality of his assignment in a quantitative fashion from the standpoint of compatibility.

The other evaluation printed out by the procedure is the restriction evaluation. This evaluation counts the number of unrestricted frequencies which are assigned to the various lists, units, and sub-unit zones. (See Figure 9.)

The current assignment produced by the computer program is shown in the two indicated columns, the previous assignment is shown in the next two indicated columns,

and the gains or losses are shown on the right. For example, the three divisions, unit C, unit A, and unit E, have the following comparison. In the previous assignment 49 unrestricted frequencies were provided to unit C in its primary list, and we moved that to 73 for a gain of 24. Unit A previously had 64 frequencies assigned, and we moved that to 76 for a gain of 12. Unit E previously had 103 unrestricted frequencies, and we moved that to 149, for a gain of 46. For the total of a field army using 1966 data, we were experiencing about a 20 percent gain over their existing assignment, about an 80 percent per corps, and a total potential gain for the entire field army looking at all the garrisons of approximately 1,200 more radio nets. 1,200 more radio nets could have been operated, assuming that re-use between garrisons was possible. To the ex-

### Restriction Comparison Sample Printout

EVALUATION LIST 2							
NO UNRESTRICTED FREQUENCIES							
UNIT	CITY/ ZONE	CURRENT ASSIGNMENT		PREVIOUS ASSIGNMENT		GAIN OR LOSS	
		PRI	ALT	PRI	ALT	PRI	ALT
LIST 2 TOTALS		59	32	30	46	29	-14
UNIT C . . . . .		73	72	49	59	24	13
	W	103	138	77	87	26	51
	W	104	143	90	86	24	57
	A	104	143	80	86	24	57
	W	105	168	89	90	16	78
	B	105	168	89	90	16	78
	S	105	168	89	90	16	78
	K	103	138	77	87	26	51
UNIT A . . . . .		76	110	64	64	12	46
	F	139	112	129	124	10	-12
	R	76	110	64	64	12	46
	G	139	112	129	124	10	-12
	F	139	112	129	124	10	-12
	H	139	112	129	124	10	-12
UNIT E . . . . .		149	62	103	137	46	-75
	A	149	67	118	151	31	-84
	M	170	165	154	155	16	10
	G	149	57	118	151	31	-94

Figure 9.

tent re-use was not possible, the 1,200 would have to be reduced.

A field army problem of 600 frequencies, 10 lists, 30 units, and 30 restricted areas requires 1 hour of setup time and 30 minutes of computer running time. This compares

with 2 weeks to solve the same problem using manual methods.

In conclusion, the procedure will provide a greater number of unrestricted frequencies, provide greater compatibility, and make frequency assignments faster.

## **NOTES**

### **SECTION VI**

### **SPECIALIZED**

### **MANAGEMENT**

# IMPROVING PROCUREMENT MANAGEMENT TECHNIQUES

HONORABLE J. RONALD FOX  
ASSISTANT SECRETARY OF THE ARMY  
(INSTALLATIONS AND LOGISTICS)

I am pleased to have this opportunity to speak to you this morning. As Assistant Secretary of the Army for Installations and Logistics, I fully appreciate the contribution which your school here is making to improved management in the Army. The two courses represented here today — Installation Management and Operations Research/Systems Analysis — represent key areas in the management of Army resources, and, based on my discussions since I arrived here earlier today, I hope that the time you have spent here and your associations with each other will serve you well in solving the complex problems you will face in your various units.

Each of us in the Army and, I suspect, most citizens of the United States are aware of the heat generated during the past year in the Congressional review of military spending — particularly weapon system procurement. There is no doubt that our management of the weapons acquisition process must be improved. The public's confidence in our ability to develop and procure weapon systems effectively and economically has been severely shaken by reports of cost overruns, performance shortfalls, and premature obsolescence. The Congress is becoming more and more dismayed and impatient at constantly escalating systems costs, and members are striking out in many directions

at what they see as mismanagement, waste, and Government-industry collusion.

Most of us who are involved in defense procurement are convinced that we have made a number of improvements in the weapons acquisition process. But we also recognize that the time has come for aggressive, far-reaching improvements which will firmly establish our control of systems acquisition and restore the public's confidence in our management of this process. I believe that unless we make these improvements, our future military posture may be seriously affected — an effect that can easily result from military appropriations cuts made by Congress in sheer frustration and result in less than optimum use of the funds appropriated for defense procurement. I assure you that we are committed to making these improvements.

I would like to present to you, as students of management, a brief description of the program which we have initiated to establish control of the immense program to procure such items as weapons, vehicles, aircraft, and communications systems. I address you as "students of management," for I recognize that this subject is not directly associated with installation management. In this role, I am sure you will recognize and appreciate the management techniques and resources which we must apply

to this program. As members of the Department of Defense, I feel that it is a subject of importance to you in terms of dollars and its consequent effect on the total budget and also in the effect which it may have on our military preparedness. Some of the areas involved will have direct implications for those of you in the OR course. We have just completed a hard look at our acquisition process, and we have identified a number of problem areas where improvements are urgently needed. However, prior to taking a series of disjointed actions to solve these problems, we have gone on to take a broader look at the entire acquisition process. I think the acquisition process can be likened to a balloon. If we simply apply another "quick fix" by pressing in one place, the balloon pops out somewhere else. I think that recent experience in attacking limited portions of the total acquisition process has proved that we

merely transfer the problem to another part of the acquisition cycle. Let me digress just a moment to say that this concept of considering the total problem, rather than individual symptoms, is generally applicable to problems including installation management.

Our aim, then, is to implement a comprehensive, integrated program of improvements. Some of our objectives lie in the area of improving the specific actions involved in project management. Other objectives include: (1) improved system definition; (2) improved cost estimating; (3) improved cost control and performance measurement; (4) control of contract changes; and (5) improved testing and evaluation prior to the decisions to enter production. You can see that these objectives cover the entire acquisition cycle from concept formulation, contract definition, all the way to final production. I would like to



**HON. J. RONALD FOX**

Dr. Fox received a B.S. in Physics from LeMoyne College. Later, Harvard awarded him two master's degrees (in Psychology and Business Administration) and a doctorate (in Psychology).

In the period 1953-57, he was a naval officer. In 1960, he co-founded the Management Systems Corp. In 1963, he was appointed Deputy Asst. Secretary of the Air Force (FM). In 1965, he became an associate professor in Harvard's Graduate School of Business Administration.

Dr. Fox assumed his present capacity in June 1969.

(This article was adapted from Dr. Fox's presentation before the Army Installation Management Course at USAMS on 31 Oct. 1969.)

speaking briefly about our major objectives in this program.

Fundamental to the entire acquisition process are the performance specifications against which the system is developed and ultimately produced. To the extent that these specifications are realistic and well thought out, they provide the basis for the orderly evolution of a weapon system. If, on the other hand, they are unrealistic, we find ourselves faced with considerable technical risk — and technical risk is one of the major sources of schedule slippage and cost growth. If the specifications are incomplete, we usually find it necessary to redirect the program or to introduce engineering changes late in the program to overcome performance deficiencies — and this provides a major source of schedule slippage and cost growth.

A logical objective, then, is to improve the method by which we develop performance specifications as expressed in the qualitative material development objectives.

As a weapon system moves into advanced development, we need to take additional actions to identify and reduce technical risks. We propose to do this by increased use of prototype competition or at least the actual working demonstration of components. This is popularly called the "fly before you buy" concept.

Our ultimate goal in improving system definition is to establish a stable technical baseline which will minimize redirections and contract changes in subsequent phases where they are major contributors to cost growth. The job of managing the weapons acquisition process should be viewed as the job of managing change. Many individuals who are not closely associated with large development or production programs mistakenly believe that pro-

curement of large defense or aerospace systems consists of writing a good contract and then waiting for the item to appear on the receiving dock. This is far from the actual case. On many development and production programs, contract changes occur as frequently as one per day. And on a few large and complex programs in the Army, Navy, and Air Force, contract changes occur as frequently as one per hour on an individual program.

We recognize, however, that some changes are inevitable. Indeed, in some cases, such as those involving technical breakthrough, changes may well be desirable. We must, therefore, establish firm control of changes to insure that they are properly analyzed prior to implementation, insuring that they are necessary and determining their impact on schedules and on systems life cycle costs. This is an area of major emphasis.

We hope to create an attitude in the Army and among our contractors that challenges each proposed change until its cost and effectiveness are fully demonstrated. Both Government and industry personnel must be convinced that engineering changes will not be a way to offset a buy-in or to "get well" from a mistakenly underestimated contract price. We are now under way within the Department of the Army to establish the necessary reviews to insure compliance with this policy.

I am sure that each of us here can appreciate that the weapon system acquisition process is dynamic. There are continual iterations of estimating, programming, and budgeting, beginning with the initial cost estimate when the system is first programmed and continuing as the system is defined through concept formulation, contract definition, development, and initial

production. We can easily see that the final cost will seldom be the same as the original estimate. The fact that the final costs of weapon systems usually exceed the original estimates is attributable in part to overoptimism, in part to our inability to quantify the unknown in the early phases of acquisition, and in part to deficiencies in our control systems.

All too often, the cost estimator is the individual who is criticized when the actual costs exceed the estimate. He is accused of coming up with an unrealistic or overly optimistic estimate. In many cases, however, I believe that the estimate was a good one, and the individuals to be questioned are those who have been controlling or not controlling the performance of work on the program — both in the contractor plant and in the Government project office.

In any event, it is clear to all of us involved in the systems acquisition process that the project manager, to be effective, needs a management information system which will provide him with early indications of developing problems, prior to the time that the Government is so deeply committed that the only alternative is to pour in more funds to save the project. The only way we can see that Government and industry can obtain this early visibility of problem areas is to compare, on a regular basis, the planned and actual cost of specific packages of work being performed. Only in this way can the Government logically consider alternatives, other than finding additional funds. While this information generally exists at various locations within a contractor's internal control system, it is rarely aggregated for the project manager in the contractor organization, and even less frequently reported on a regular basis

to the Government. Indeed, in the past, there has been no formal requirement that this information be presented to either project manager.

Traditionally, the project manager has not been fully effective at managing costs, because he usually finds out about problems through a review of historical data. The primary method of financial control on many projects takes the form of tracking the rate of consuming funds — and while this technique is useful in making sure that funds are not spent too fast or too slowly in terms of calendar periods, it provides little assistance in determining whether specific packages of work are being accomplished at a cost higher or lower than planned. By tracking the rate of expenditure, the project manager is largely concerned with funds management instead of cost management. While tracking the rate of spending funds is an important function, it is a far cry from cost management. Funds management is quite different from the task of agreeing with a contractor on a performance requirement and then regularly reviewing progress and engaging in the difficult task of negotiating between Government and industry to insure that the desired performance is achieved for the budgeted dollars.

Another area, which has received much publicity, is our plan to conduct "should cost" studies in connection with weapon system acquisition. At the point of source selection for development and production, we need to insure that the contractor's proposed cost is the result of motivation to produce efficiently. In a true price-competitive situation, we can usually rely on the impetus of competition to promote efficient methods. But true price competition rarely exists when we are buying something never de-

veloped or produced before. In the absence of price competition we must turn to cost analysis or price analysis for this assurance. I would like to speak a few minutes about what this means.

Traditionally, as you may know, this analysis has been based largely on a review of a contractor's historical performance, regardless of his efficiency or lack of efficiency. Costs which are clearly not allowable are excluded, but little or no effort is made to determine what the cost might be under efficient labor and material standards, competitive subcontracting, and management control practices that are efficient and comparable to those employed on commercial projects.

A "should cost" analysis, on the other hand, starts with the assumption that a contractor will be reasonably efficient. This procedure results in an analysis of a contractor's proposal to determine what a system should cost under circumstances comparable to those on commercial projects. The "should cost" studies are based on a rigorous application of engineering and work measurement techniques. Experiences such as those gained by the Navy in the "should cost" study on the F-111 engines, point out that this approach is valuable in developing a Government negotiation position which approaches that which would evolve if price competition existed. The nature and depth of each "should cost" study will, of course, depend upon the particular system and contractor.

Our goal in this program is to effectively manage the acquisition of weapon systems and the resources available to us. Our program seeks to insure that we know what we want to buy, and that we establish a firm technical baseline against which to develop and procure the system. We must then establish

management information systems which provide our managers with the timely information necessary to exercise positive control of the system program. Only by such a coordinated approach can we insure the attainment of our goal.

We are now implementing the necessary management tools to attack the problem. But we need to develop increased proficiency in the use of these tools by our project management and procurement personnel.

I feel that we are entering a very challenging period in the management of the acquisition process — a period of increasing effectiveness, and a period of emphasis on intelligent action that places more substance behind the vu-graphs, brochures, and "get well" plans that we have all seen for so many years.

I hope that individuals in Government, and industry as well, will be ever mindful of the significant amount of our tax dollar set aside for defense programs. We have a clear responsibility to insure that our projects are well managed and that they can easily sustain the examination of public scrutiny.

To return to the issue of the day, I congratulate each of you in the Army Installation Management Course for completing this course but also for volunteering and accepting the challenge of participating in this training to perform the difficult and demanding tasks which confront today's managers. Certainly one of the greatest challenges now facing all of us is the satisfaction of the requirement to manage our installations more effectively and efficiently with fewer and fewer tax dollars. I have discussed one such program going on today in the Army. I hope that you will seek opportunities to exert your managerial influence in initiating or sustaining similar pro-



HONORABLE J. RONALD FOX

[179]

grams, and I hope you will realize seeing the success of your efforts. I  
the satisfaction that comes from wish you well.

# **NON-APPROPRIATED FUNDS— SOURCES, USES, PROGRAMS**

**LIEUTENANT COLONEL PAUL J. FRASER,  
CHIEF, NON-APPROPRIATED FUNDS DIVISION,  
ARMY EDUCATION AND MORALE SUPPORT  
DIRECTORATE.  
OFFICE OF THE ADJUTANT GENERAL,  
DEPARTMENT OF THE ARMY**

**T**he role of assisting commanders in the management of their resources is a vital one. Non-appropriated fund activities are concerned principally with managing two essential resources — money and people.

No matter what one's regular duty in the Army, knowledge of the Army system of non-appropriated funds is useful to all of us in managing our resources. Most command programs are affected in some way by non-appropriated fund activities, perhaps to a degree seldom realized.

It is the purpose here to provide information which will be helpful to Army managers in their regular duties. You will readily recognize from the information presented, the things you can do at your home station to be a better manager with respect to non-appropriated funds, or in other activities in your sphere of influence.

This discussion will be divided into three main parts. First, a basic description of the non-appropriated fund system; second, data to show the magnitude, scope, and uses of non-appropriated funds; third, discussion of some of the principal programs in which we are now engaged Army-wide.

## **I. NON-APPROPRIATED FUND SYSTEM**

**Definitions.** What do we mean when we speak of non-appropriated funds? The term is used in two ways: one, to refer to money, not appropriated by the Congress, generated by soldiers and employees, and used for their collective benefit; and, two, to refer to the financial organization established to administer the money. When used in the latter sense, a non-appropriated fund is an unincorporated financial entity, established by authority of the Secretary of the Army, for the purpose of administering the monies for the benefit of the people who generated them in the first place.

**Basic policy concept.** It is the basic policy of the Department of Defense and of the Department of the Army to promote the mental and physical well-being of its personnel by providing comprehensive welfare, morale, and recreational programs. For this purpose, free-time facilities will be provided, operated, and maintained through funds appropriated by the Congress, supplemented by non-appropriated funds.

**Command responsibility.** Operation and supervision of non-appropriated funds is a command respon-

sibility. Each commander will assign such military personnel or civilian employees to specific duties as may be required to exercise adequate supervision over these activities. A council (or board of governors) and a custodian is required for each fund to assist the responsible commander in exercising control.

**DA responsibilities.** Headquarters, Department of the Army, is responsible for determining and establishing policies and operational principles for non-appropriated funds. General staff supervision is vested in the Deputy Chief of Staff for Personnel. The Adjutant General is assigned operational and administrative functions in the system, under the policy guidance of the Deputy Chief of Staff for Personnel, principally for administering Department of the Army central

funds deposits, and in recommending systems, procedures, budgets, policies, and personnel directives. The Non-Appropriated Funds Division, Army Education and Morale Support Directorate, performs the functions assigned the Adjutant General in this area.

**Types of Funds.** There are three general categories of funds: revenue-producing; welfare; and sundry.

Revenue-producing funds are those established primarily to administer the sale of merchandise and services at reasonable rates to military personnel and their dependents, and to eligible civilian employees; secondarily, to generate a net financial return to be used for the collective benefit of personnel served. Revenue-producing funds make monetary distributions to welfare funds only.



**LT. COL. PAUL J. FRASER**

Col. Fraser is a graduate of the University of Maryland, has done post-graduate work at the University of Maryland, and has completed the Associate Advanced Officer course at The Adjutant General's School.

He was an instructor in personnel management and Army administration at The Adjutant General's School. He has also served as Assistant AG in U. S. Army, Europe; MAAG, Vietnam; U. S. Army, Hawaii; Sixth U. S. Army; and as AG of the 7th Infantry Division.

(This article was adapted from Col. Fraser's presentation before the Army Installation Management Course at USAMS on 28 Jan. 1970.)

The principal revenue funds are: exchanges, motion picture theaters, book departments, post restaurants, and armed services newspapers.

Profits from Army and Air Force exchanges and motion picture services operations are distributed for military welfare activities of the two services.

Book departments are operated by service school commandants to provide supplies and training materials, not otherwise issued to the students, for use in furtherance of military education. Profits support commandants' welfare funds.

Post restaurants provide facilities and services for civilian employees. Profits are used for civilian welfare purposes through Civilian Welfare Funds.

Armed services newspaper fund publish and circulate theater newspapers, such as the *Stars and Stripes*, and distribute popular newspapers and magazines overseas. Profits support the major overseas commanders' welfare funds.

By joint agreement, the Secretaries of the Army and Air Force have vested operating responsibility for exchanges and motion picture theaters in the Board of Directors, Army and Air Force Exchange and Motion Picture Services. Responsibility for all other Army non-appropriated funds and related programs and activities is vested in the Army's Deputy Chief of Staff for Personnel.

**Welfare funds.** Welfare funds receive and disburse monies derived from revenue-producing funds, to support morale, welfare, and recreational programs collectively benefiting Armed Forces personnel or employees. The types of welfare funds include Army Central Welfare Funds, Major Command Welfare Funds, Central Post Funds, Unit Funds, Commandants' Welfare Funds, and Civilian Welfare Funds.

The Army Central Welfare Fund, administered by my office, is a central depository from which redistributions are made to major commanders for their own military morale programs. The principal source of income for the Army Central Welfare Fund is the profits from Exchanges and Motion Picture Services.

Major command welfare funds finance morale and recreational activities benefiting military personnel within the respective major commands. They receive dividends from the Army Central Welfare Fund through command channels.

Within the continental United States, major command welfare funds are established at the headquarters of each army area. In overseas areas, major command welfare funds may be established by major commanders and, in turn, by their major subordinate commanders.

Central post funds supplement appropriated funds by providing equipment, supplies, and services for military personnel of their respective installations. A central post fund may be established at each installation occupied by two or more units. There will be only one central post fund at an installation. Central post funds receive dividends from the appropriate major command welfare fund.

Unit funds provide money for the procurement of articles or services which are not available from appropriated funds for the welfare of military personnel of the unit to which the fund pertains. Unit funds may be established by commanders of organizations smaller than battalions, such as companies, troops, batteries, bands, and detachments. Unit funds receive dividends from central post funds.

Sundry funds perform a combination of the functions of revenue-

producing and welfare funds. They benefit limited groups of military personnel, their dependents, and eligible civilian employees, or a combination of such personnel, associated in voluntary membership. Sundry funds may be established by the appropriate commander for such purposes as he may consider proper, to provide essential morale or recreation services which cannot be provided by another authorized source. Sundry funds do not declare or pay dividends in any form and do not receive grants from revenue-producing or welfare funds. They are largely self-supporting. Profits generated by sundry fund activities are retained and used to finance the specific programs for which the funds were established. Individuals derive benefits from sundry funds exclusively through participation in, or patronage, of the funds' programs.

Some examples of sundry funds are the Army Central Mess Fund, Overseas Major Command Mess Fund, Open Mess Funds, Chaplains' Funds, and others such as Army Flying Clubs, Rod and Gun Clubs, guest house funds, and billeting funds.

The Army Central Mess Fund is the central depository in the Department of the Army authorized to receive residual assets of dissolved open messes within the continental United States, and dissolved overseas open messes, when the major command is inactivated. Redistribution of available funds may be made through loans to open messes. The Army Central Mess Fund is administered by my office.

Overseas Major Command Mess Funds are established in overseas areas to perform a function similar to that performed by the Army Central Mess Fund for the continental United States. Overseas major command mess funds have

been established in Headquarters, United States Army, Europe; United States Army, Pacific; and United States Army, Vietnam.

Open Mess Fund is the official designation for what is commonly referred to as an officers' or non-commissioned officers' club. Open messes may be established at an installation with the approval of the installation commander. Open messes provide essential morale and recreation services for commissioned officers, warrant officers, and non-commissioned officers and their dependents. Open messes are afforded broad authority in which to provide services for the members. For example, a mess may, and usually does, operate a restaurant and a bar, and often may provide dancing and night club-type entertainment. Some messes operate packaged alcoholic beverage stores (in CONUS these must be approved by Headquarters, Department of the Army), golf courses, and other services or recreational activities. As a general rule, messes will not compete with exchange activities.

Chaplains' funds support and promote the spiritual and social activities related to the religious programs of each command. Income normally is provided by voluntary offerings and donations. Funds are segregated according to basic religious groups (Catholic, Protestant, Jewish).

**Distribution of welfare funds.** The system for distribution of welfare funds throughout the Army follows a fairly simple concept.

The Army non-appropriated welfare fund program is financed primarily from profits generated by the Army and Air Force Exchange and Motion Picture Services. Profits which are disposable as dividends (as determined by the Army and Air Force Board of Directors) are paid to the Central Welfare Funds

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of the Army and Air Force in proportion to their respective troop strengths. The present system of dividend distribution of exchange and motion picture profits between Army and Air Force was established in 1956 by the Board of Directors, Army and Air Force Exchange and Motion Picture Services. (Prior to 1956, distribution was made on the basis of the ratios of profit generated by each service.) Each year, the board declares the dividends based on anticipated earnings. Each service then breaks out its share in accordance with its own procedures. The Army uses a per capita distribution. Other welfare income is generated locally by minor income-producing activities, such as bowling centers. Locally generated income is retained locally.

Figure 1 shows the flow of money from the Army Central Welfare Fund. The fund distributes dividend credits to the major commands on a per capita basis, at rates determined annually by the Deputy Chief of Staff for Personnel. The major commanders, in turn, distribute dividend credits to installation central post funds, also on a per capita basis, at predetermined rates. Cash payments are made against these credits when needed to meet 30-day cash requirements of the receiving funds. Unit fund dividends are paid monthly by central post funds on a per capita basis at fixed rates as the credits accrue.

Central post funds normally support command service activities such as sports programs, library services, craft shops, entertainment, troop education, to name just a few examples. Unit funds finance unit dayrooms and other programs determined by unit commanders. Distribution to unit funds is made on a monthly basis. Unit fund programs are in addition to the in-

stallation programs, which are paid for directly by the central post fund.

**Dividend rates.** Table I shows the per capita dividend rates for FY 1969 and FY 1970. The FY 1970 per capita dividend rates for CONUS are the same as for FY 1969. The per capita cost of operating recreational facilities is greater at smaller installations than at larger installations. This fact is recognized by the sliding scale in this CONUS distribution table. Oversea commands are funded at a flat rate. This rate was increased from \$3.00 to \$2.25 for FY 1970 for overseas except that the USARV dividend is computed at \$3.00. Oversea commanders determine the system and amounts of distribution within their commands. The per capita rates, applied to each command's strengths, determine the dividend amounts.

The Army Central Welfare Fund distributes all of its dividends, as a normal rule. Except for administrative costs and sufficient funds to operate DA-sponsored programs, all income is distributed to the major commands. Dividend distribution rates are determined by the DCSPER based on projected income and the command budgetary requirements. Unfunded requirements are also considered.

The Army Central Welfare Fund redistributes money received in the form of quarterly dividend credits to the major command accounts. These credits are made at the beginning of each quarter, based on the strengths reported for the immediately preceding quarter. A report, "Schedule of Average Military Strength by Table of Regular Dividends" (DA Form 1843), is prepared by each command and submitted quarterly to my office. The amount of dividends for each major command is a consolidation of the

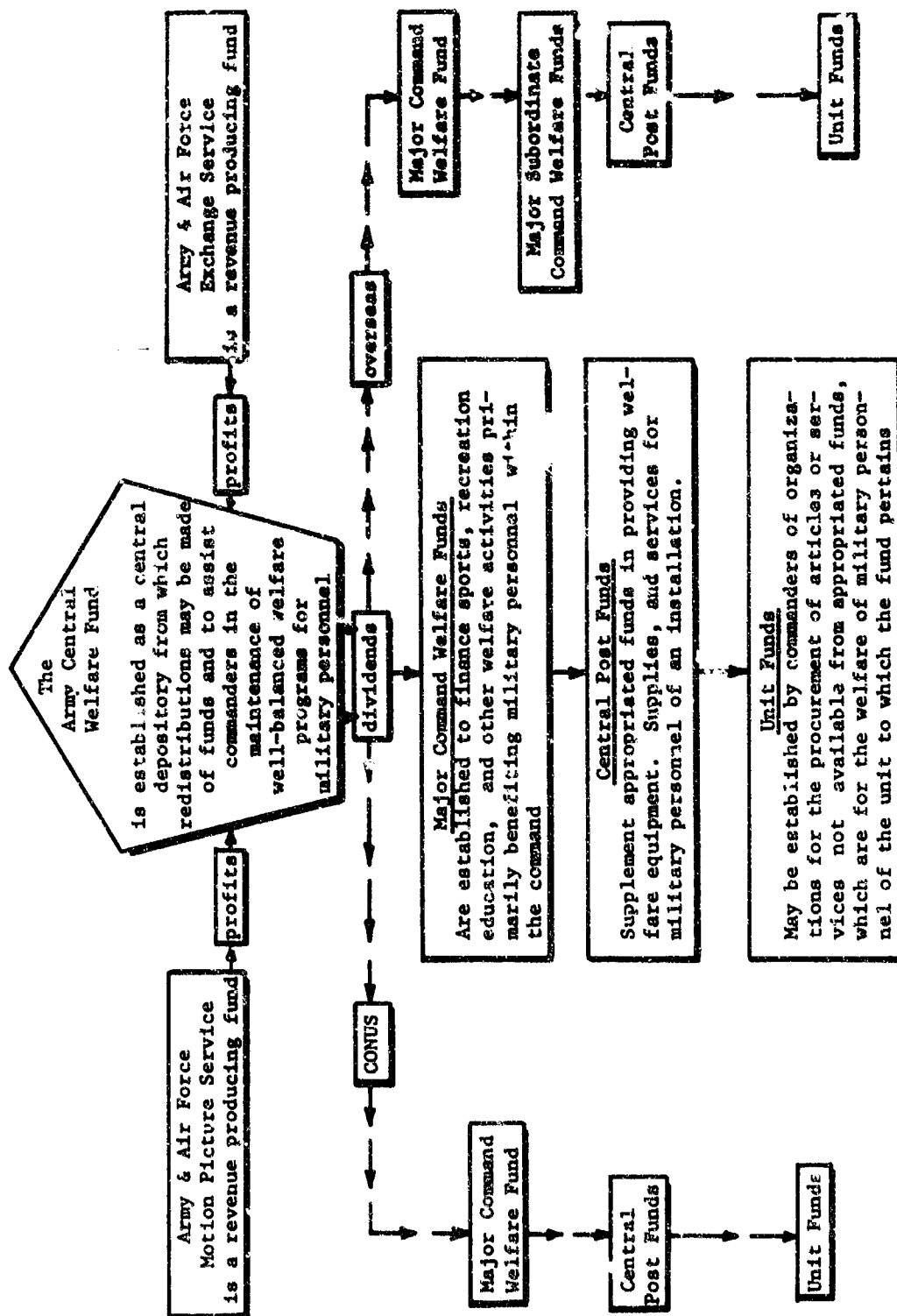


Figure 1. Welfare funds distribution.

TABLE I  
PER CAPITA DIVIDEND RATES  
FISCAL YEAR 1969 AND FY 1970

POST STRENGTH	CONUS PER CAPITA MONTHLY RATES			
	MAJ CMD WELFARE FUNDS	CENTRAL POST FUNDS	UNIT FUNDS	TOTAL
0 - 999	\$1.45	\$1.00	\$0.50	\$2.95
1,000 - 1,999	1.40	.95	.50	2.85
2,000 - 2,999	1.35	.90	.50	2.75
3,000 - 3,999	1.30	.85	.50	2.65
4,000 - 4,999	1.25	.80	.50	2.55
5,000 - 9,999	1.20	.75	.50	2.45
10,000 - 14,999	1.15	.70	.50	2.35
15,000 - 19,999	1.10	.65	.50	2.25
20,000 - 24,999	1.05	.60	.50	2.15
25,000 AND OVER	1.00	.55	.50	2.05

OVERSEAS: \$3.00 per man per month for FY 1969.

\$3.25 per man per month for FY 1970.

average quarterly strength figures multiplied by appropriate rates for each strength category. Each major command submits this report to us quarterly, based on strengths for the preceding quarter. This report provides the basis for dividend distributions.

Section I of the report, Average Military Strength, contains the monthly and quarterly average daily strength figures supported by each type of fund, plus totals, derived from morning reports. Each fund prepares the report and forwards it through the command chain. Each command consolidates. In CONUS, a separate line is completed containing strengths by types of funds, i.e., unit funds, stockade funds, central post funds, isolated unit funds, inmates' funds, reserve component funds, and totals. This is done because each type of fund has its own dividend rate. Overseas commands report only the total strengths because a single flat dividend rate applies.

Section II of the report, Dividends Receivable, contains the monetary amounts derived by multiplying each of the strength figures in Section I by the appropriate rate for each type of fund.

Accuracy in strength reporting is absolutely essential to insure proper and equitable dividend distributions at all funding levels. This is especially important to insure a fair share distribution of dividends to the Army Central Welfare Fund from the Army and Air Force Exchange and Motion Picture Services, because distribution is based on the actual head counts shown on these reports.

## II. MAGNITUDE AND USES OF NON-APPROPRIATED FUNDS

**General.** A commander necessarily must be concerned with many matters, but none is more important to him than the morale of his people. The state of this intangible asset so often determines the success or failure of commanders. For



this reason, the Army puts much effort and money into its welfare and recreation programs. These programs deserve to be managed wisely, to get the best possible benefits for the greatest number of people. Let's look at the magnitude of some of these operations.

When we speak of morale, welfare, and recreation activities, we are talking about big business. These are not small-time operations. This fact is illustrated by the following statistics.

The exchange service grossed almost \$2 billion last fiscal year. Army open messes generated over \$221 million in sales. Motion pictures grossed over \$28½ million. Book departments sold almost \$6½ million in goods to students.

Sources of money for command welfare, morale and recreation programs. In FY 1970, the Army major commands budgeted for welfare, morale and recreation purposes \$143.3 million in combined appropriated and non-appropriated funds, and reported unfunded requirements for \$76.6 million more (the latter mostly for construction).

Funds to support the FY 1970 welfare and recreation budget of \$143.3 million will come from several sources:

\$51.0 million will come from the Army Central Welfare Fund.

\$70.8 million will come from appropriated funds.

\$20.3 million will come from self-generated income. (Self-generated income includes contributions, donations, sales of property, minor income-producing activities, income from bowling centers and Class VI stores.)

\$1.2 million will come from the net worth of commands (major commands and installations combined).

In summary:

Non-appropriated fund support

will be \$72.5 million, or 51%

Appropriated fund support will be \$70.8 million, or 49%

Total \$143.3 million — 100%

As indicated earlier, it is announced DA policy to provide recreational free-time facilities from appropriated funds, supplemented by non-appropriated monies. Despite this policy, however, for the past 14 years appropriated funds have furnished less than half our Army-wide needs. In the Army Education and Morale Support Directorate, we have had a long-standing in-house goal of a 50-50 split. We will almost, but not quite, reach it this year. If you have any role in the budgeting process, please help to provide the appropriated monies the programs deserve. We have too many unfunded needs for which we could be spending the non-appropriated dollar.

**Uses of Recreation Money.** Let's look to see how the budget is divided by use. Figure 2 shows the degree of support commanders provide in their spending for each of the various programs. Five special services programs will take 60¢ of every dollar; sports, 17½%; entertainment, 4%; crafts, 9½%; libraries, 1%; service clubs, 12%. "All other expenses" include such items as information and education, Special Services administration, R&R facilities, youth activities, and community services facilities. Chaplains' activities, administration, bowling, and unit funds, make up the balance of the budget.

It was mentioned earlier that \$72.5 million of the welfare budget will come from non-appropriated sources, \$51.0 million from the Army Central Welfare Fund, and \$1.2 million from net worth of commands. Let's look at these figures again from the standpoint of an abbreviated statement of operation and net worth.

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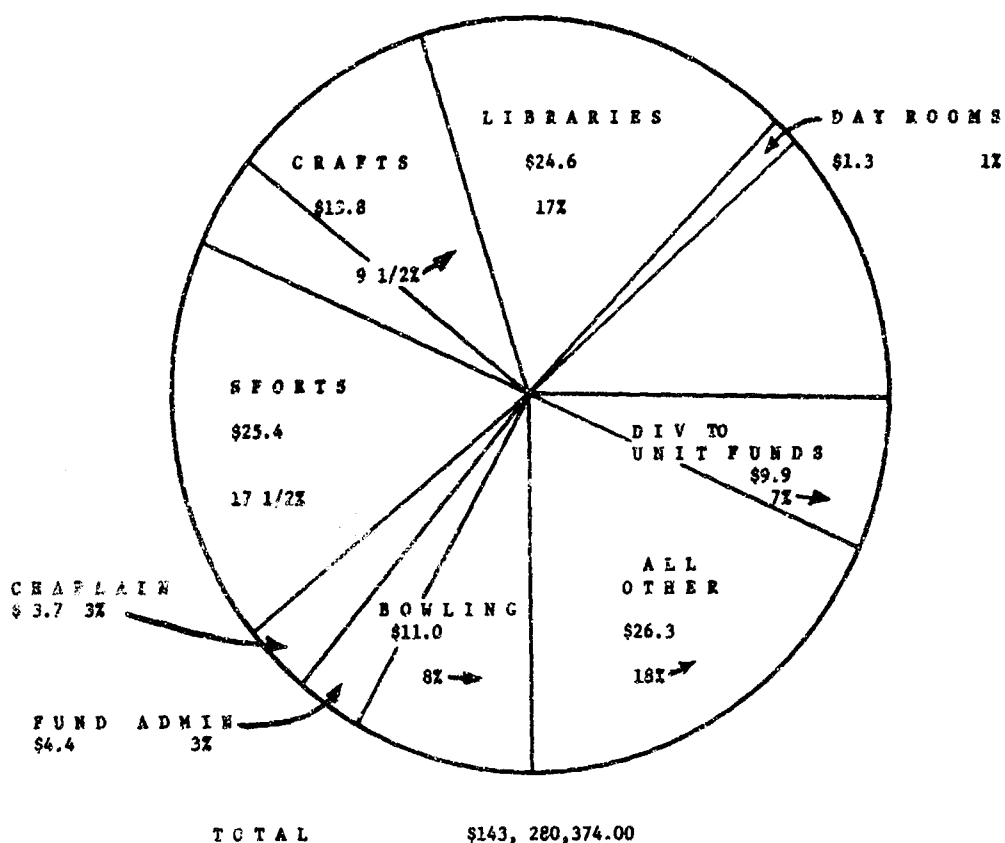


Figure 2. How appropriated and non-appropriated funds will be spent during FY 70 (in millions).

As shown in Table II, major commanders and their central post funds started the FY 1970 budget year with a combined total net worth of \$42.8 million. Income projection is \$71.3 million. Expenditures, including dividends to unit funds, will be \$72.5 million. Expenditures over income will result in a draw-down of net worth in the amount of \$1.2 million, leaving an ending net worth of \$41.6 million. Note this last figure. It seems obvious that any command with a substantial uncommitted and unrestricted net worth certainly should consider using some of this money to meet a few of their unfunded requirements. The money should not be just socked away for a rainy day.

The Army Central Welfare Fund began the year worth \$13.8 million. Income from the exchange system

is expected to be \$46.4 million. Other income of \$1.9 million will be principally the interest on our investment portfolio. This interest income is possible because we retain all dividend money until actually required on a 30-day cash basis by each major command. We expect very little from the motion picture services because of their projected construction requirements. We expect to pay out \$51.0 million in dividends, more than we take in. These dividends become the income for the subordinate reporting commands. Other expense will consist primarily of grants and administration costs. This will result in a draw-down of net worth of \$3.6 million, leaving an ending net worth of about \$10.2 million. All of this net worth is restricted in the sense that reserves have been established to cover the difference

TABLE II

MAJOR ARMY COMMAND AND ARMY CENTRAL WELFARE FUND  
OPERATIONS AND NET WORTH  
FOR FISCAL YEAR 1970

MAJOR ARMY COMMANDS		ARMY CENTRAL WELFARE FUND	
	Millions		Millions
BEG NET WORTH	\$42.8	BEG NET WORTH	\$13.8
INCOME:		INCOME:	
ACWF (CONUS)	\$21.8	AAFES	\$46.4
ACWF (OVERSEAS)	29.2	AAFMPS	.4
OTHER	20.3	OTHER	1.9
TOTAL INCOME	\$71.3	TOTAL INCOME	\$48.7
EXPENSE:		EXPENSE:	
MAJOR COMMANDS	\$ 2.3	DIV TO CONUS	\$21.8
CENTRAL POST FUNDS	60.3	DIV TO OVERSEAS	29.2
UNIT FUND DIV	9.9	OTHER	1.3
TOTAL EXPENSE	\$72.5	TOTAL EXPENSE	\$52.3
INCREASE (DECREASE)	(\$ 1.2)	INCREASE (DECREASE)	(\$ 3.6)
END NET WORTH	\$41.6	END NET WORTH	\$10.2

in cost and market values of the government securities held by the fund, and to meet commitments for programs previously approved.

**The five-year forecast.** Now we have just discussed a lot of figures and statistics. Where do these data come from? They originate in the annual five-year budgets and the quarterly financial statements submitted by each major command. These reports include all central post fund activities.

The Non-appropriated Welfare Fund Budget was changed from a one-year to a five-year budget beginning with FY 1969. This change coincides with the Army and Air Force Exchange Service five-year plan and the appropriated fund five-year plan. The system allows both short- and long-range planning for the best use of non-appropriated fund resources and a greater degree of continuity in the use of non-appropriated funds. Since the military construction (MCA) program is planned over a five-year period, both the non-appropriated five-year budget and the MCA program can be tied together to get more MCA money. Not only does the five-year budget provide commands with a useful planning tool, it provides DA with a means to help maintain the stability of the dividend rate structure. Commanders cannot afford wide annual fluctuations, such as we experienced in the past.

**Precautions in budget preparation.** We have noted the following in budget preparation. There is a trend among most commands to emphasize programming for the next year coming up, but there is little programming effort for the next four years. Unfunded requirements, in many instances, are not projected beyond the first year. It is very important to include all unfunded requirements for each year.

These unfunded requirements have great weight when the Board of Directors, Army and Air Force Exchange and Motion Picture Services, meets to determine future dividends to the Army Central Welfare Fund. Stated unfunded requirements also have a great bearing on any supplemental dividend distributions. We need to have all requirements stated very carefully and accurately.

We urge commanders to build their welfare programs around actual needs and to use the dividend projections as the basis for funding the most essential of such program needs. Dividends, plus resources already on hand, necessarily limit what can be spent. If requirements exceed resources, then priorities for spending must be established. Any requirements of low priority which exceed available resources should be listed as unfunded requirements.

### III. DA Programs

Thus far, we have discussed the basic non-appropriated fund system and the magnitude and scope of operations. Let's now turn to some of the on-going and planned DA projects affecting non-appropriate fund activities. Some of these may be of interest to you.

The Non-appropriated Funds Division attempts to keep control of these projects and to keep them moving. It gets difficult sometimes because, like appropriated fund activities, non-appropriated funds also have money and space shortages. It seems that in this Army we always come down to management of scarcities.

There are 23 non-appropriated fund employees and 2 officers in the Non-appropriated Fund Division. The assistant chief is the custodian for 8 funds which we now administer.

Figure 3 shows how the office is organized. The branch titles give a clue as to the functions performed and the operational responsibilities for the programs to be discussed next.

**Non-appropriated fund personnel system.** It must be confessed that the Non-appropriated Funds System has many thousands of employees over this world, but we don't know how many. We are trying to find out. Also, for many years we have had no personnel system in being for these people. We are trying to create one.

On 1 June 1969, as far as the Non-appropriated Fund Personnel Program is concerned, we invented the wheel. This expresses how far behind the times we are. On that date, AR 230-2 was effective. Six of the eventual 19 chapters have been published. We will fill in these other spokes of the wheel as soon as possible. Ten of the remaining 13 chapters are being staffed, and the 3 being written are near completion.

Over the past few years, there has been real and increasing interest in non-appropriated fund employment from many high-level sources, including the Congress, the Department of Defense, the Civil Service Commission, and the Bureau of the Budget, as well as from employee unions. The failure to develop a program for these employees would, inevitably, result in legislation under which we would be forced to operate. Those who are familiar with the civil service system are well aware of the problems which are sometimes created by well-meaning legislators who, because of agency inaction, establish programs they think are necessary. So if an agency wants its own program, it had better build it. Another, and even more compelling, reason for providing a personnel program for these employees is that, as Department of the Army employees, they are entitled, so far as possible, to treatment comparable to that afforded all other employees of the Department.

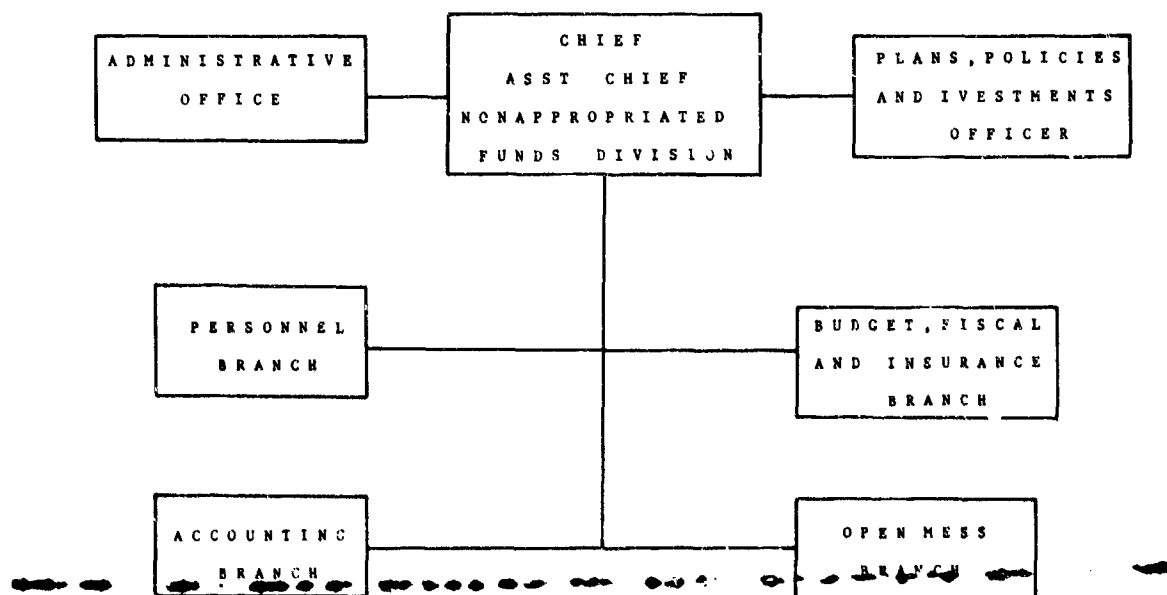


Figure 3. Non-Appropriated Funds Division organization.

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The Department of the Army has employed non-appropriated fund personnel for almost 100 years. They are working in many diverse activities. You will find them in all of the Special Services programs, including the service clubs, sports, entertainment, arts and crafts, etc. They are also employed by the libraries, the open messes, the Golf Clubs, Class VI stores, the Central Post Fund, Central Accounting Offices, and other activities.

During all these years, no official action of any kind was taken to insure equitable treatment for non-appropriated fund employees until the issuance of AR 230-2. Non-appropriated fund employees were second-class citizens!

In the past, pay, leave, and other employee benefits for non-appropriated fund employees varied from command to command, from installation to installation, and even from fund to fund within a single installation. Uniform treatment simply did not exist.

Work on the non-appropriated Fund Personnel Program was begun in January 1968 and has continued at a steady pace since that time. When completed, the regulation will constitute a foundation for building a complete personnel system for our employees to give them status and tenure, and the benefits to which they are entitled. We have a long way to go, but we have begun the journey.

The non-appropriate fund group insurance and retirement plans were begun on 1 January 1966. They are integral parts of the personnel system being developed. Under these plans, basic health and life insurance is provided on a voluntary basis, with costs shared by employees and employer funds. Participation in the retirement plan is mandatory for all full- and part-time regular permanent employees,

also on a cost-sharing basis. This plan, together with Social Security, provides retirement benefits at age 62 comparable to benefits for civil service personnel. Aetna Life Insurance Company underwrites the group health and life insurance. The group retirement plan is carried by Bankers Life Insurance Company of Nebraska. Preliminary personnel employee strength reports reveal we should have about 13,000 enrolled in these plans.

**Centralized investment program.** As indicated previously, the Army Central Welfare Fund maintains an investment portfolio in government securities. We believe we can offer a service to non-appropriated sundry funds by investing their idle money for them. The going interest rate on new securities issues is now at a very high level. On 30 April 1969, we announced a central non-appropriated fund investment program open to sundry funds worldwide.

The current rate offered is 6%. We review this rate quarterly and adjust it for administrative costs and losses caused by market fluctuations. Deposits may be made or withdrawn any time in \$100 increments. Interest is computed to date of withdrawal. This program has a decided advantage for many open messes who cannot get more than 5% or 5½% and who must keep minimum balances for specified periods of time in order to get those rates.

The program is slowly gaining momentum. We now have nearly \$4,000,000 on deposit. But we believe there is a potential of \$30,000,000 more in idle funds or inadequately used funds, which, if invested at maximum yield, would net about \$1,560,000 annually for the owners of this money. Any open mess with an acid test ratio of 2:1

or better, in almost every case, will have money it can safely invest without impairing its operating capital requirements.

**Non-appropriated fund centralized accounting.** Non-appropriated fund activities have been described as big business. Even though we have been administering funds for many years, we are still in the horse and buggy era when it comes to use of effective business techniques. We have grown big haphazardly. Figuratively speaking, many of our funds are operating independently, with their bookkeepers wearing green eye shades, sitting on high-legged stools, and writing with quill pens. We are trying to do something about it.

Centralized accounting and personnel administration at installation level is being studied now in a pilot project at Fort Rucker to determine whether we can effectively modernize.

Each fund at the installation will continue to determine its own affairs, but the central office will provide certain services at less total cost and we hope more efficiently. Each contributing fund will share a pro rata portion of the costs. Accounting and disbursing will be computerized or mechanized. The personnel functions will be phased in as people are trained. After one year of experience in this pilot project, we may be able to reach some conclusion on what methods would be suitable for implementation at other installations. In the meantime, Army regulations authorize and encourage installation commanders to centralize on their own initiative.

**Open mess warrant officer military occupational speciality career program.** The last four programs and projects to be discussed all represent attempts to improve our open mess system, Army-wide.

One of our biggest problems in open messes is the shortage of trained, qualified mess secretaries and managers. Over two-thirds of all officer open messes are managed by young lieutenants with two- or three-year military obligations. By the time they get the experience to quality as a club manager, they are released to civilian life. Older, more experienced officers avoid repetitive open mess assignments due to the necessity to become branch qualified in all areas of their career fields. We have concluded that if we are to improve open mess management, we must develop a core of professional club managers who will remain in the open mess field in a career status. For this, we have turned to warrant officers. A career field with an identifiable MOS for warrant officers as open mess secretaries has been approved. Currently there are many warrant officers serving as open mess secretaries who are doing outstanding jobs. It is absolutely essential to any organization, and particularly important to open messes, that there be professionalism attached to management. The open mess secretary is the key to the success of any open mess. His job requires that he be professionally qualified to perform his duties. If we can attract warrant officers to this field as a career, we can put new life and continuity into the program. We are also doing something similar for NCO's as mess managers. MOS specifications are now being developed in OPO, who will soon seek the comments and recommendations of the major commands. Revised staffing guides also will be considered.

**Open mess loan program.** The Army Central Mess Fund provides financial assistance in the form of loans to open messes in CONUS. Major overseas commands have similar funds.

The loan program was established in 1954 to assist in the renovation, expansion, and new construction of open messes within the CONUS. The intent is to provide assistance (not subsidy). Before loans are made, resources of each applicant open mess are first applied toward the cost of improvements. These resources are then supplemented by loans. Funds available for loans consist of about \$2,000,000 in the Army Central Mess Fund, plus \$6,000,000 in available loan credit from the Army Central Welfare Fund. At the present time, we have about \$5.0 million outstanding in unpaid loan balances. The funds are utilized on a revolving basis. Repayments are made quarterly. As repayments come in, new loans are made. 3% interest per annum is charged to borrowing messes, computed at  $\frac{1}{4}$  of 1% interest a month on the outstanding balance. Interest received on money borrowed from the Army Central Welfare Fund is paid to the Central Welfare Fund. Interest on money lent from the Army Central Mess Fund itself is, of course, retained by the mess fund. Loans are repayable in the minimum possible time, depending on ability to repay, with the maximum time 5 years.

Sixty-one loans were approved during fiscal years 1963 through 1969, totaling \$14,267,864.00. In order to assist more open messes, the line of credit for loans from the Army Central Welfare Fund was increased from \$3 million to \$4 million in November 1964, and again increased in 1968 to \$6 million. This loan program, supplementing available resources of the open messes, has assisted many open messes in improving their facilities tremendously. In a few cases, some projects exceeded \$1,000,000 each, considering both the mess assets and loans combined. The Fort Sam

Houston NCO Open Mess, Fort Carson OOM, and Fort Gordon NCO Open Mess are a few of the most recent ones of such magnitude.

**Open mess beverage decal sale program.** The Army Central Mess Fund does not have sufficient funds to meet the demands for assistance. We now have a small program to generate more money to lend. In April of this year we began the sale of alcoholic beverage control decals at \$50 per thousand, to open messes in CONUS, Alaska, and Hawaii. All funds generated from the sale of decals are fully applied to the loan program. We expect this program to increase the funds available for loan by \$500,000 annually. Overseas commands are authorized and invited to purchase these control decals at cost. They may then sell them to open messes at a profit to augment their own open mess funds.

**Open mess credit card system.** The last major project for discussion is one that is still in the drawing board stage.

There is a demand building up to expand the credit system most clubs now run independently. There is a need apparently for a worldwide credit card system which would serve officers and NCO's wherever they are, but usable only in Army open messes. (Perhaps in the future all the services could cooperate on a single system, but that is nowhere near, at this point.)

We have obtained conceptual approval from DCSPER to establish a pilot project for officers' open messes in CONUS starting with one of the Army areas, which is yet undetermined.

There are many commercial firms such as Bank Americard and Interbank Master Charge which are willing to perform this function. But the commercial discounts are ex-



tremely expensive (3% of gross credit sales to the messes themselves and 1½% per month to the member on unpaid balances.) We have investigated the possibility of setting up a contract with a bank offering both computer and financial services, so as to design a system uniquely tailored to Army messes only. We believe this to be a better and less expensive system than the commercial system. The costs would be based on computer service time-sharing rather than discounts on sales as is the case with most credit card systems. We are now developing specifications for contract bids. A time frame will be established to bring in all CONUS officer messes. It will take a year or more to get this much in operation. If the project is successful, we could expand to oversea officer messes, after which we could bring in NCO messes.

We believe we can save open messes the costs they now have of

running their own credit systems, or a substantial portion of these costs. We would do this by investing the cash flow the system would generate, together with investing the idle cash now in the mess system. Much more will be published officially on this project as the details are developed.

#### Conclusion

My purpose has been to furnish information only. I hope some of you in your official capacities can use this information to help manage non-appropriated funds at the installation level on an efficient businesslike basis. We desperately need good management of these programs to get the most return for the least money for our soldiers. Non-appropriated money belongs to the people who generate the income. Let's all try to see that we get our money's worth wherever we can contribute our talents.

# CIVILIAN PERSONNEL MANAGEMENT

MR. JAMIE D. LAWHN,  
DIRECTOR OF CIVILIAN PERSONNEL,  
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Perhaps the first thing I should do is to correct any erroneous impression that my title "Director of Civilian Personnel" might give. I would like to take this opportunity to say that I do not really direct anyone. I serve as an advisor. I have the unique experience of advising, rather than directing, in the civilian personnel field.

The Combat Developments Command has 25 operating civilian personnel offices supporting the activities of the command throughout the nation. How does the CDC get them to perform their role in its support?

The concept has evolved whereby the personnel officer, no matter whom he services, becomes the staff official of the activity serviced. In accordance with this concept, we have placed the civilian personnel officer at each activity on the CDC staff. He receives his orders, instructions, and letter of authority from CDC and becomes responsive to CDC.

My purpose is not to discuss CDC civilian personnel management as such but only as it might relate to overall civilian personnel management within the Army. My purpose is twofold: to give an idea of where we stand as relates to the management of the civilian work force in the Army, and to discuss what is needed to improve on this. I will touch upon the role played by man-

agers, supervisors, employees, and commanders with respect to civilian personnel management. Lastly, I will make some reference to the Civil Service Commission and to unions.

At the outset, I would like to make it clear that nothing I say is intended to be derogatory or defamatory. I am, of course, interested in improving civilian personnel management: that is what I want to get across. What I have to say is close to home in the sense that it represents one man's opinion and one man's experience. It does not necessarily represent the opinion of the Army in some matters.

Let us consider some past history. Before World War II, in 1939, there were some 250,000 employees within the Federal Service in all government agencies, including the U. S. Army. By the end of 1939, the number had grown considerably, and by the early 1940's the number increased to 4,000,000 employees. During this period, the ordinary regulations, principles, and policies for employment in the government service were vastly modified to accommodate the rapid growth. Great and sweeping short cuts and changes were made in testing and recruitment procedures.

The number of personnel specialists throughout the nation that were available to direct and man-

age the civilian personnel function were very few. Nothing like the great and rapid growth had really ever occurred before and there were many gaps in administration. Where there were not enough managers, supervisors, or directors — call them what you will — they had to be trained. Consequently, there was an overnight increase in the number of leaders. People who were not necessarily equipped to take over leadership functions were placed in jobs requiring leadership. However, they were the best we had and they did a tremendous job over the years.

During this particular era, the Department of the Army was very fortunate in being able to bring in at the top level some of the personnel managers from the major industries. These individuals ini-

tiated a training program not only for the personnel people but also for the managers, who had limited experience. Of course, while these individuals were primarily geared toward profit motivation, the others were geared toward mission motivation.

Even today, some of the problems of those days still exist. One of them is the big brother concept in problem-solving. Under this concept, some managers assumed the role of their brother's keeper and did his thinking for him. There was a gradual moving away from good relations in the work force where this concept was allowed to go unchecked.

We moved from untrained to highly trained personnel in both the leadership area and the skilled worker area. We had to train the



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The depression in the 1930's interrupted Mr. Lawhn's pursuit of a college degree. Consequently, his expertise as a personnel manager is the product of self-development, Army training, and experience. However, long after he had achieved recognition in this field, he attended Roosevelt University in the early 1960's to round out his development.

Mr. Lawhn is well qualified to speak on all aspects of civilian personnel management. He has over 28 years of experience in this field, at both the operating and policy levels. His career record is reflective of the Army policy on utilization and mobility of civilian employees. He has served in several CONUS commands and in two overseas commands and is currently employed as the Civilian Advisor to CDC on civilian personnel matters.

(This article was adapted from Mr. Lawhn's presentation before the Army Installation Management Course at USAMS on 23 Sep. 1969.)

men and women in the personnel offices too. Let's face it: some shoe clerks had to become personnel managers and supervisors. Throughout all of the transitional period, none of us really had the basic skills; we had to learn the hard way.

I think the essence of the situation can be summarized by an instance of what we were faced with in the civilian personnel field. At one point, we had to take second lieutenants who, after 90 days of officer candidate school, came in as civilian personnel officers to direct the civilian personnel program. Obviously, they had not been trained for this, but many of these individuals are still around today and are excellent personnel managers.

But those were some of the problems that we were faced with in 1939. The work group that we had was not composed of young men in the early war years; the young men were going into uniform. The work group was composed mainly of the older group — those in their thirties or a little older. We did hire some of the younger men, but they would work for six months or so, after which the draft would call them.

By 1950, all of us untrained shoe clerks were now highly developed managers, supervisors, and personnel specialists. We were so highly developed that when the Korean conflict broke out, bringing with it a great build-up, we were able to move with relative ease without many of the problems of World War II. We had learned lessons from World War II in the civilian personnel field, lessons in supervision and management which became our tools and stock in trade. We learned how to manage and equip the work force to do its job, and we learned how to strengthen

personnel management within the installation.

For the first time in the history of the Army we had strong written policies, regulations, and guidance on civilian personnel management. We were now able to say, "This is what the book says: these are the principles and policies that we are supposed to follow." Now that we had the principles and policies in the book, certain new terms were beginning to permeate the spoken words of supervisors, managers, and other personnel people. These new terms were competitive merit, equality in pay, and equality in opportunity.

There were many of us in the personnel field who became explorers, because, while we did have certain processes that we followed, they were rather tight and narrow. We became explorers in finding better ways to do things, in finding better techniques. We became explorers in trying to answer such questions as, How do we know we are paying the right salary for certain positions? How do we know we are getting the right kind of people for the job? How do we know whether the right people are seeking opportunity to compete for promotion?

During this period, the personnel staff became highly responsive to management. They were asking what they could do to help, but they were more oriented to management's needs and less oriented to the employees' needs.

We began to experience one particular problem that is still with us today, the restrictive channels for problem-solving. This was self-defeating and left you with the problem remaining in your office. Because of the restrictive channels, your efforts to solve a problem were defeated from the start.

I refer to the 1950-59 period as the era of ups and downs. Many highly trained personnel people assumed that they had reached the top as far as being experts in their field was concerned. They thought that they could call their shots with the utmost accuracy and be professionally and scientifically accurate in everything they did. The end result was that each thought that he was more accurate than the other. In some instances, an employee would be assigned one grade today and an entirely different one the next year, so that employees would move up and down the pay scale like yo-yos.

There were a lot of little things that were having their impact on the situation. For one thing, there was the control on manpower spaces which fluctuated greatly and frequently and which sometimes had the same impact as a reduction in force in that the work force would be moved from one job to another. They would go down, then up, then up and down. And, while we had strong policies and regulations and the experts to interpret them, we found that the written words were subject to manipulative interpretation. Many have perhaps heard of the supervisor who, because he can't fire an employee, decides to abolish the job to accomplish this purpose, intending to reestablish the job at a later date and hire someone else.

As for the job description, when it was discovered that, for a similar job, a certain grade was assigned, that job description would be copied in the hope that the same grade could be obtained, even though the job might be different in substance.

Problems that occurred during the 1950's are still with us as far as their impact is concerned. Some RIF actions that occurred years ago are still being talked about today.

Some classification downgrading that occurred years ago is also still being discussed today. Questions of military personnel and civilian personnel doing the same jobs are still being discussed.

During this particular era, we began to recognize that our worldwide commitments had created a new type of employment problem. We had so-called expatriates that is, U. S. citizens working for the U. S. Government throughout the world. The question became one of how we would move these people back and forth to give them an opportunity to come back to the U. S. and see what was going on within the Army structure. Some expressed the opinion that these employees did not want to come back; they had been in the U. S. in 1939 and knew what the Depression had done to the U. S. They were enjoying their life overseas, the higher pay, and the value of the dollar in terms of housing.

However, by and large, the U. S. citizens did want to come back. But they also wanted security, so the interchange program was developed according to which one employee would be brought home and one would go over in his place. This created a requirement for mobility on the part of the worker. There were problems such as re-employment rights, in addition. I would venture to say that out of 100 people who, with re-employment rights, take overseas assignments, not more than 5% ever come back to the job they left. The reason seems to be that such individuals see that opportunities are great for those who expand their horizons beyond the one installation. Having valued their oversea experience, they also recognize that they can gain by moving into other installations or commands in CONUS other than

the ones they were in and move onward into an expanded career.

In 1960, some of the problems of the past began to come to a head. For one thing, there was the rebirth of the union movement. It was bound to come; it was not necessarily attributable to some of our shortcomings as managers, supervisors, and personnel people. It is in the scheme of things in a democracy. It may have come sooner than we expected, but it came. And at the time, President Kennedy issued an executive order to try and give some sense and substance to what was being done in the union movement.

During this period, we suddenly awakened to the fact that some of the principles, philosophies, verdicts, etc., that we had on paper were just that, so much paper. They weren't necessarily being practiced. So there was a renewed interest in such matters as equal opportunity, although in some cases it could be said it really didn't come to pass and just remained a verdict on paper.

Another thing that began to occur around 1960 was that some of us with receding hairlines and graying hair, realizing that we were growing older, began to show some interest in the future work force. Those of us who were working at the installation level became worried about some younger people taking over.

In the 1960's we were also plagued by the continuation of controls on manpower spaces and funds. There was no certainty, no positive path that could be followed. There was gradual recognition of the fact that the classification system had become outmoded. There were still some restricted channels and the frustrations of being confronted with those channels.

We were not moving fast enough in recognition of these problems. Congress was beginning to take an interest, and finally the Department of the Army realized that if it didn't move a little faster regarding policy and change, Congress might pass a law that would be even more restrictive than any the Department of Army could impose on itself.

One of the changes was the so-called merit promotion program, which has now become pretty familiar. The Civil Service Commission put out a policy and the Army put out a regulation to demonstrate to Congress that we could establish a concept that the work force would support.

We also recognized need for training for our people. So the training act was passed according to which there is now much more opportunity for training for the work force — academic training, contract training, in-house training, and training between government agencies. There was very little of this type of thing in the 1940's and 1950's. Much of what was learned, was learned by the seat of our pants.

Congress today is very interested in labor relations. They are interested in laws that will correct some of the problems about which constituents have complained.

Today, in the government service we have some three million employees. In the Army, we have 380,000. And today in the Army upward of 150,000 of this 380,000 belong to one union or another. Labor and management are now learning to sit down together, and the big brother concept is out the window. The employer now has a big stick with him when he sits down at the table to talk.

Today there is great awareness of our responsibility to provide equal opportunity for everyone.

Managers, supervisors, the personnel staff, commanders, union leaders, employees — all of them have an awareness of our responsibility. That doesn't mean, of course, that all of us do the right thing all the time; it just means that we have an awareness that we have a responsibility.

The Chief of Staff of the Army directed the Assistant Chief of Staff for Force Development to include in the program and budget guidance 4,000 positions that commanders will earmark for the recruitment of career interns, i.e., young college graduates. This will be stated in specific numbers by career programs and commands by the Deputy Chief of Staff for Personnel in conjunction with the functional chiefs of the various career programs. Such action does not result in an increase in manpower spaces; it comes out of our hide, and is a hard core decision that the Army must plan now for the future civilian work force.

The Chief of Staff of the Army also directed the Comptroller of the Army to identify approximately \$32 million in support funding to pay 4,000 interns during the first year of the five-year program. In other words, this isn't just one year; this is going to go on for five years. Such action will not include a budget increase, but it will require additional administrative control, as the \$32 million is intended only for the employment and recruitment of interns. This is fine for the Army, but what about the rest of the Civil Service employees? We are only 380,000 out of the three million. Unless similar action is taken by all the government agencies, those that take action like this will become training grounds. Our young interns will benefit us as long as we can keep them, but at the same time their

job opportunities will increase by leaps and bounds. How can we keep them? That is our problem. We are not going to keep them by ignoring them; we have got to provide them with dignity in the job they are doing; we have to give them the opportunity to grow, the opportunity to see the big picture of the Army, the opportunity to move and become mobile. If we don't, the rest of the government agencies will swallow them up and \$32 million will go down the drain.

Today there is great recognition of the need to modify channel restrictions. The first regulation is now in the books, and that is the one on equal opportunity. Another that is scheduled to go into the books soon is on appeals and grievances. The concept is to permit taking the shortest possible straight line to the highest decision-maker, to by-pass the intervening channels that are frustrating.

The Army and the Civil Service Commission together will attempt to train and select highly qualified individuals to handle these kinds of appeals. I cannot give detailed information in terms of how the appeals system is going to work in the Army. This has yet to be settled. Tentative plans have been developed which include grievance examiners working out of the Secretary of Army's office on a regional basis. When a problem occurs at an installation like, say, Fort Benning or Fort Belvoir, the commander there will contact the regional office and state that he needs a hearing examiner. The man will come in, and at first he will try a conciliatory effort, seeking facts and taking an around-the-table approach. He will then lay it on the line as to what he has found up to that point, without a full hearing. The commander will have an opportunity to question the employee,

and vice versa. If no agreement is reached between employee and manager, the case comes to a hearing. And then the examiner will proceed with the normal routine of a hearing.

The report on the decision to be made will not be given to the commander concerned; it will by-pass him and go to a major command level. If the appeal examiner's recommendation is not accepted at the major command, it has to be sent forward to the Secretary of the Army for decision.

Basically, there is one level of decision, as opposed to the current process in which the instruction commander is the decision maker at the first level, and the employee can appeal this decision to the major commander. If the employee still objects, the case goes to the Secretary of the Army.

In some commands, now, there are four echelons to go through before one finally gets to the top level where a decision can be made. A final Army decision will cut all of this short.

We thought great strides were being made in the incentive awards program when we gave the directors certain authority to approve awards, and I think great strides were made by this delegation.

In the past, the approvals for awards went through a committee. The committee would look at some cases and say that, yes, they approve this or that group. In reality, they didn't know Joe Doakes from Bill Brown.

It was said that we should take it out of the hands of these committees, the members of which cannot really distinguish whether a specific award is justified or not because they are not that close to the situation. What happened? Some directors began to set up their own committees. The whole concept of

the delegation was to keep personnel management in the channels of supervision, to keep decision-making in the channels of supervision.

The commander of CDC has solved this problem. He has issued a letter of authority to his directors within the headquarters. He told the directors that they were given the authority to approve; they were not to establish any committees, that such action would be routed through supervisory channels and acted upon through supervisory channels. And that is the way it is done.

You would be surprised at how fast the actions go through. There is no waiting six months for a decision. Employees are not supposed to be told they are being put in for an award, but if they do get wind of it and it takes a long time for it to come through, there could be a morale problem. Under the new system, the action goes through much faster. Today we are facing some of the problems that we have faced before. For one thing, there is a reduction in force. During fiscal year 1968, the Army lost 13,000 civilian jobs. This followed a tremendous civilianization program in which some installations converted many military jobs to civilian slots.

Regardless of the problems of reductions in force and the problems created by civilianization, the policy remains the same. Civilians may not be replaced by military except for those reasons outlined in the Army Regulation on the utilization of manpower.

Unless you want some real sticky problems, don't replace civilians with military. The exceptions are those outlined in the appropriate regulations. You will doubtless have trouble either with some Congressman or union leader if you attempt to replace civilians with military.



Even today, we find that our managers, supervisors, and personnel staff are struggling in their personnel role. We tend to become authoritative and regulatory-minded. We have mixed attitudes; in some cases we don't know whether we are fish or fowl. When management sits down with a union representative, occasionally management finds itself at odds with itself. We don't present a solid posture in all cases.

In many cases we are not prepared to talk as a personnel official, supervisor, or manager. Believe me, when you sit down to talk with a union representative, you know that he has read the book. He can quote chapter and verse, paragraph, and page number. You had better know the book too.

If both sides will agree that this is what the book says, then they can get away from the book and from the authoritative and regulatory approach. They can then become participative and consultative. In this connection, I have noticed that there are some very healthy attitudes in those installations where there is this exploratory approach to problem-solving. Management is at its best when it knows its role, knows which side of the table it belongs on, and reveals its expertise in talking with employee representatives and finding out what their problems are.

I would like to conclude by dwelling for a few moments on some of the things I expect to see in the near future.

There is the problem of recognizing the aging work force. There

is the problem of rebuilding another work force, and I think we can expect the Navy, Air Force, and other government agencies to react in much the same way that the Army has reacted. In the Army Materiel Command, for example, they have one of the most magnificent recruiting programs I think the government has ever seen. For their college recruitment program they have a special staff which goes to all the universities and colleges throughout the nation.

On the other hand, very little attention has been given to the question of the carpenter shop, the plumbing shop, the repair shop, etc. Looking around inside one of these shops, you know that many of the workers are going to retire on the same day. Somewhere along the line, this problem has to be addressed. Also, there is expected to be greater union involvement at both the local and national levels.

There will be increased interest in equal employment. The demand will come for action and not rationalization. But here is an interesting statistic: out of about 3,300 interns employed by the Army in FY 69, only 175 came from minority groups. And I regret to say that the civilian career fields had this low intake. You can bet your bottom dollar that we are going to do something about that.

Finally, we will see a coming of age in labor-management relations. Labor and management will achieve fuller recognition of their roles and become experts in working together for improvements in personnel management.

## **NOTES**

## **SECTION VII**

### **MANAGERIAL TECHNIQUES**

# CREATIVE PROBLEM-SOLVING

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When I was asked if I would lecture here on "Creative Problem-Solving," I was very pleased with the opportunity because this is a field which I have found to be exciting, enlightening, and challenging. It has been interesting to me that several people just this morning have asked how I happened to make the jump from mathematics to creative problem-solving. In reality, there has been no jump, since I had been teaching math for some years before becoming interested in the study of creative problem-solving, and have since been teaching both. There is little doubt in my mind that my math teaching has become more effective with this background in creative problem-solving. The general field of creative studies, as we are now teaching it, has many implications for study in the traditional subject matter fields.

The entire field of creativity is comparatively new in the academic world. I hope this morning to give you a better understanding of it, as well as to challenge you a bit so that you will realize more of your creative potential than you have previously. Everyone is creative to a certain extent. Our goal today is to help you to understand just enough more about your own creativity that you will be able to nurture that creative potential which

you already have but which, for one reason or another, you fail to recognize and/or apply.

To begin, may I ask you to do a short exercise in ideation? On a piece of paper, please write some ideas of how you would improve the chair you are sitting in. Think only of good ideas, i.e., ways in which you feel you could make a better chair out of it. You will have three minutes. Now please put this aside and we will return to it later.

Before discussing the specifics of creative problem-solving, let us define some of our terms. David Page was reputed to have said, "If to be educated is to possess knowledge, then an encyclopedia is better educated than a man." This quote has many implications. In the field of computing, in which I have had some experience, I still believe that a machine can do little more than a man can program it to do. Because of a primary difference between man and machine, I have little fear that machines will rule mankind. That most critical difference is man's applied imagination, man's creativity, which the machine does not possess.

It was Albert Einstein who said that "imagination is more important than knowledge." This does not presume that we should underestimate knowledge, which is basic to all that we do with our imagina-

tion. Perhaps we should say instead that knowledge, as well as imagination (and evaluation), is necessary to creativity.

What is creativity? Just what are we talking about when we use this term creativity? You probably have heard the story of the engineering class in which the instructor wanted to determine how creative his students were; to see how much ingenuity they had. He gave each of them a barometer and asked how each would use it to measure the height of a certain building. One of the boys said, "I understand that a falling object accelerates at 32 feet per second per second. I'll drop it and find out how long it takes for it to hit the ground." Another boy said, "I'll measure the barometer. Then I'll walk up the stairs and mark the length of it on the wall up one flight of stairs.

Then I'll multiply this by the number of flights of stairs, and that will give me an estimate of the height." Another one said, "I'll put the barometer on the end of a rope, I'll walk to the top of the building and drop the barometer off, and then I'll measure the length of the rope where it touches the ground." The instructor received all sorts of responses, when one of the boys finally said, "Well, I'm going down to the basement to find the janitor and I'll give him the barometer if he can tell me how high the building is." Is this creativity?

What constitutes creativity? Something different? Totally new? Useful? Valuable? All of these are to be considered. Let us say there is a certain aspect of newness or of innovation in creativity and also of value, but not necessarily to anyone but the creator. Abraham Mas-



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She has been an instructor at the Univ. of Buffalo, a WAVE officer, a research associate to the Creative Education Foundation at Buffalo State University College, and professorial lecturer in mathematics at Millard Fillmore College (SUNY/B). She is also presently associate professor in Creative Studies and associate director of the Creative Problem-Solving Institute at the Buffalo State University College.

Dr. Noller has lectured on mathematics and creative problem-solving before numerous groups — social, civic, business, church, and others.

(This article was adapted from Dr. Noller's presentation before the Army Installation Management Course at USAMS on 18 Feb. 1969. Copyright 1969 by The Creative Education Foundation, Inc. Used with permission.)

low has said that a woman baking a good pie might be considered more creative than an artist painting a bad picture. Let us keep in mind, then, that in order for something to be considered creative it will probably possess some element of newness, innovation; be different; have some originality; and also that it will be of value to someone, possibly only the creator, and not necessarily to anyone else.

What is a creative act for one person may not be creative for another. Why? Partially because of differences in individuals' backgrounds. For example, if we were to give a child in this geographic area a toy balloon and he would proceed to blow it up, we wouldn't be surprised and wouldn't judge it to be a particularly creative act. He would no doubt have had some experience with balloons. He would no doubt have seen them, have handled them, and have known what he would be expected to do with a balloon.

But if we were to take a balloon to an area where a child had never seen one, and that child would manipulate it, would play with it, and finally would blow it up, we would consider that a creative act. That child would have had no previous experience to tell him what he should do or what he might do with a toy balloon.

We will begin, then, by defining creativity as a function of past experience or of knowledge, and of what we do with that knowledge (through imagination and judgment, as we shall see later.)

Let me describe an analogy to creativity. Visualize, if you will, a kaleidoscope, a toy with which we are all familiar. It has a drum containing bits and pieces or objects of plastic, metal, or glass. As we turn the drum, these pieces move about and changing patterns

result. The more pieces in the drum, the more potential arrangements are possible. And, as the drum ceases to turn, so the arrangements or patterns cease to form.

This could be compared with what occurs during our mental activity. We are all products of our past experience. We have stored within our memories, whether we realize it or not, the events of our lifetime. But, until we manipulate those memories, until we turn the drum of the kaleidoscope of our past experience and of our stored information, we fail to obtain new configurations. This is essentially, then, what our imagination can do for us: by turning the drum of our knowledge and past experience, we form new configurations, new patterns, not only of thought but of suggested behavior as well. The more facts available, the more patterns or new ideas are possible.

However, when the drum stops turning, or the imagination ceases to be applied, the new patterns or ideas cease to form. This, then, is what we suggest you do: that you use your imagination to turn that drum, and to *deliberately* form new patterns. This helps us to further define creativity as the imaginative formation of new relationships, new patterns, from previously gained knowledge or experience.

There is another toy, or rather a modification of this same kaleidoscope, called a teleidoscope, which is probably illustrative of an even better analogy. Instead of having to depend upon just the bits and pieces of material already within the drum for forming the patterns, the teleidoscope has an open end through which reflections of all objects in the environment can enter into the picture. As in life, therefore, since we are not living within a vacuum but in an ever-changing

environment, everything that exists or that happens around us may immediately become a part of our experience.

The more aware we are of what is happening around us, the better we may perform. We have available all that surrounds us, to use as we wish, to help us in the turning of this drum to form new patterns. We may gain from each other, we may gain from everything occurring in our environment.

Have you ever stopped to realize that if you and I each have a dollar and we exchange dollars, we will each still have only one dollar?; but if you and I each have an idea and we exchange ideas, we will both have two ideas? This happens in our experience. When we assume the blinders of insensitivity toward each other and toward what goes on around us, we deprive ourselves of the privilege of observing and absorbing much that is happening in our environment. This is, then, what the teleidoscope illustrates: we need not depend entirely upon what is in the drum, but rather we have available everything within "sensing" distance of the drum as well.

We recognize, first of all, the importance of knowledge, secondly, and of no less importance, the manipulation of that knowledge to form new patterns or ideas. This is the deliberate application of the imagination.

A third consideration and again of no less importance than knowledge and imagination, is the element of evaluation, the judgment of what are the best patterns after we have manipulated that knowledge. Basically, these are the three foundations of creativity, and of creative problem-solving, and complete our definition, i.e., as a function of knowledge, imagination, and evaluation.

Now, the question arises: can we educate for creativity? Yes, we believe we can because we have done it. We and many others have conducted some very successful programs in the teaching of creative problem-solving and in the enhancement of creativity. We feel that the enhancement of creativity can be thought of as the enhancement of a skill. You and the next fellow both know how to swim. But if one of you receives instruction in certain techniques and gains an understanding of how he might improve his swimming, with practice and sincere effort on his part to do so he probably will become a better swimmer than the other.

Everyone, as has been said, is creative to a certain extent, some being more creative than others. However, with a knowledge of certain techniques, followed by practice in applying them, we are able to help ourselves to become more creative. We cannot make you more creative than you potentially are, but it is doubtful that you really make the best use of the capabilities which you have. With an understanding of the inhibitors of creativity, as well as of those techniques which promote creativity, and a deliberate attempt to practice them, you can help yourself to become more creative.

We have successfully taught creative problem-solving at the secondary, college, and the adult education level, through "senior citizen" age. It is also being taught effectively at the elementary as well as the pre-school level. Drs. Crutchfield and Covington in California, for example, present a sixth grade course in creative problem-solving while Dr. Elizabeth Starkweather in Oklahoma is working with children of nursery school age and younger. It is hopeful that with such educational emphases

we will lessen the "fourth-grade slump" in creativity which Dr. E. Paul Torrance found in his research.

With this introduction, I would now like to challenge you: it is

doubtful that any one of you is as creative as you could be. Therefore, we will discuss some of the means through which you may help yourself to become more creative.



Figure 1.

What do you see in the picture being shown? (Figure 1.) When you looked at it first, how many of you saw the birds flying to the left? How many of you saw the birds flying to the right? How many saw them flying both ways? After you realized that you could see them going in both directions, what particular feeling did you have? You might have felt cheated if you hadn't seen them both immediately, or you might have had a feeling of disappointment, together with the

thought that you had missed something by not seeing both. You might have had a feeling of pleasure and accomplishment.

In any case, this is an example of one of the things that we can do for ourselves, to become more aware of what's going on around us, and to realize that there may often be more there than meets the eye; there is usually another way of looking at an object or a situation, beyond the immediate, obvious one. This is typical of much that

happens around us every day, in whatever we do, wherever we go. Therefore, how about challenging ourselves to having the eye to meet the object or the situation as it *really* is, or could be?

When we say we are going to apply the creative problem-solving methodology, we are saying, first, that there is a problem or a challenge which we are going to do something about. In this process of meeting a challenge, we are essentially going to be doing one of two things; either changing or adapting our environment to satisfy us or the challenge at hand, or changing and adapting ourselves to satisfy our environment. In the bird picture, you must change your way of looking at it in order to see the birds flying in both directions. The picture doesn't change, the environment doesn't change. There are often situations in which you will find yourself when the environment probably will not change. Therefore, in order to meet the challenge, it may be necessary for you to be the flexible agent, for you to change yourself.

To continue with some of the techniques to help us to become more creative and some of the deterrents which prevent us from fully realizing our creative potential, one of the greatest of the latter is habit. It is so easy to continue to do things in an habitual way, without giving any thought to questioning the advisability of following that pattern!

For example, clasp your hands in front of you and you will notice that one of your thumbs is on top of the other. Now, pull your hands apart and clasp them again in the opposite way, so that the other thumb is on top. You may say that it isn't comfortable the other way. No, it seldom is the first time we try it. We have been in the habit

of doing it in a certain way for so long that we do find it uncomfortable to do it in a different way. In reality, we *think* just as habitually and it is just as difficult to tear away from well established thought patterns.

Fold your arms. You will notice in most cases that you have one hand up and the other tucked down. Now, pull your arms apart and fold them in the opposite way. Again you will probably find this change to be uncomfortable. There have been people who have said, "I can't do it." But they can and you can. It takes effort to break a habit, and often thinking creatively in a non-habitual way is just as difficult as breaking a physical habit. We are not suggesting that all habits are bad or that habits are wrong, but only that habits should be questioned. We may find it uncomfortable to question our habitual ways of thinking and subsequently to break away from them, but it is not impossible.

Without looking at your wristwatch, can you tell me without a doubt how the numeral four is represented on it? Is it a Roman numeral four? Is it an Arabic four? Is it a slash mark or a dot or no mark at all? You may be absolutely sure what it is, but it is probable that you have looked at your watch many times a day and yet have not really seen the numeral four. You may well argue that you don't care what the four looks like because when you look at your watch all you are interested in is the time, and you can tell that at a glance. But, could you identify your own wristwatch with a certainty? Perhaps not if you aren't sure of the four. In the same way, by being as fully observant as possible of what goes on around you is one way of taking full advantage of experience and knowledge that you should not



deprive yourself of having. Again, it takes deliberate effort and practice to look at things in a more careful and less habitual way.

How many squares do you see in this figure? (Figure 2.) You say 16, 17, 21, more? Your immediate,

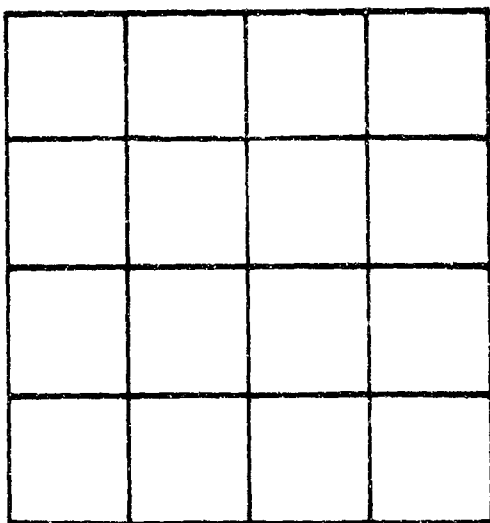


Figure 2.

habitual response was 16 because you look at it as a four-by-four configuration. However, the question asked was not in terms of *small* squares, but simply squares. One student, in response to this, saw an infinite quantity of squares because it appeared to him to represent an endless pile of glass bricks. Only when we extend beyond the habitual way of looking at something will we begin to see what additional implications there might be.

You probably all remember the patriotic picture, "The Spirit of '76." In that picture there are three figures of people in the foreground. Can you remember exactly what those three people are doing, or what they are carrying? You say that one is playing a fife, one a drum, and one is carrying a flag. Does anyone disagree? If not, no one has looked at it carefully

enough because there is no one in the front row carrying a flag. (Figure 3.)

We have five basic senses. Psychologists suggest that there are probably many more than that, but we do know the five basic senses. However, we usually short-change ourselves because we really do not use these senses to fullest advantage. We look at things, but we don't really see them. We listen to things but don't really hear them. We touch things but don't really feel them. When we walk to a corner store, for example, we usually do *just* that. That's the sole purpose we have in mind, to walk to the corner, and we fail to observe things to the right or to the left on the way. This attitude dictates much of what we do in our lives, and because of it we are missing so much which could come to us from all directions and become a part of our experience, of our awareness.

There are some basic attributes of creativity which we can test for through some of the standardized creativity tests. These abilities include flexibility, fluency, and originality of thought, sensitivity to problems, and elaboration of ideas. There is one particular attribute of a creative person, which is concerned with flexibility, which has to do with the ability to change one's point of view, as mentioned earlier. We might say that flexibility is being able to see things in a different sense, or set; being able to put yourself in the other fellow's shoes; again, being able to change your way of looking at something — an object or a situation.

What do you see in this figure? (Figure 4.) If you are looking at it as white on black, you probably see a compote or bowl, or a vase, a birdbath, etc. If your are looking at it from the point of view of black



Figure 3.



Figure 4.

on white, you probably see two silhouettes, two persons facing each other. In this picture, not unlike the bird picture, if you are able to change your point of view, you may readily see one interpretation and

then the other. In both cases your mind organizes and interprets what your eyes see, relating the visualization to your past experience. This is essentially what you may do to help yourself to be more creative in an approach to a problem: to change your way of looking at an object or a situation in order to see it from the other fellow's point of view. In so doing, you may avail yourself of additional facts to aid in the organization and interpretation of what you see.

The following is perhaps a more difficult illustration of the same principle, which is exemplified by George Perkins Marsh's statement that, "Sight is a faculty; seeing is an art." (Figure 5.) How many are able to see this as a picture of



Figure 6.

a young woman? How many as an older woman? How many are able to see both? They are both there. Again, you must be flexible enough to shift from one viewpoint to another. The picture doesn't change, your way of looking at it must change. When we think creatively, we must often be able to refocus our attention or change our direction of thought.

In addition to this ability to "shift gears" in our patterns of perception and thought, we often find much advantage in applying what we refer to as incubation during problem-solving. Deliberately putting a problem aside for a time and "sleeping" on it often leads us to a whole new train of thought and, ultimately, to our best solution. Whenever possible, it is most advantageous to allow yourself time for incubation between periods of idea-finding and the subsequent evaluation of those ideas to choose which are the best. Often we might think that an idea comes to us out of the blue, but it is more likely that this has resulted from unconscious or pre-conscious thought; not something that appears on the spur of the moment, but rather has

been planned for, has been thought about, and then has materialized after a period of incubation.

Another way in which we often short-change ourselves, inhibiting our own creative potential, is through our lack of effort in using certain thought patterns. Each and every one of us probably knows more about almost anything than we think we do. Never underestimate the knowledge, the information, that you have stored in your experience. By simply putting forth extra mental effort, although it may be one of the hardest things you do, you may accomplish some mental gymnastics far beyond your own expectations.

For example, if you were asked to list the names of 20 birds and you were not a bird-watcher, you would probably respond that you simply don't know that many. However, through a systematic approach in the form of a checklist you could probably think of several categories of birds such as: everyday birds around the neighborhood, water birds, farm birds, game birds, domesticated birds kept as pets, etc. By putting forth just a bit more effort than is necessary to simply think of birds off-the-top-of-the-head, you could undoubtedly think of many more than the 20 asked for. The use of a checklist to facilitate the extra effort affords a most convenient technique for ideation.

Another serious inhibitor of creativity is conformity in thought. Dr. Joseph McPherson, a psychologist with the Dow Chemical Company, has said, "Conformity in human behavior is often a necessity, but conformity in human thought is a danger." You have the capability of being different and original in thought from others around you. Why not take advantage of this uniqueness which you possess? It is solely your responsibility; you

can do it. How? Perhaps by making more fruitful use of the word *WHY*. This small word is one of the most powerful in our vocabularies. It is possible that one of the reasons for childrens' creativity levelling off at too early an age is because of their being discouraged from posing the question *why?*, putting the damper on inquisitive, original thought. We too often put this damper on creative, non-conforming thought on the part of all whom we work and associate with. We are, in effect, conditioning them to conform in their thought patterns by not encouraging more extensive use of the word *why*.

Now, how do we associate these aspects of creativity with creative problem-solving? We teach creative problem-solving as a process; as a methodology composed of essentially the same three basic elements which have already been mentioned in the definition of creativity, i.e., knowledge, the manipulation of that knowledge, and, finally, the judgment of the ideas obtained from that manipulation.

We may outline this in the five steps as we present them in the instructional materials used in our course in creative problem-solving at the State University in Buffalo. These materials are now being used throughout the world by people who have attended our Annual Creative Problem-Solving Institute and have returned to their own areas to inaugurate programs and institutes. This summer's Institute in Buffalo will be the 15th Annual and it would probably be a conservative estimate to say that at least 3,000 persons have now participated in either these Institutes or in our college classes.

The five steps in this systematic approach to a creative solution to a problem are: fact-finding, problem-finding, idea-finding, solution-

finding, and acceptance-finding. First, we attempt to find all the facts we can about any situation or object. For example, in thinking about how to improve your chair you could observe it with regard to its size, color, shape, its age, texture, substance, structure, etc. If you are concerned with a challenge regarding a situation, you may use the familiar checklist of who, what, when, where, why, and how to obtain facts.

Secondly, after discovering all the facts we can, we define and re-define our problem. John Dewey said, "A problem well defined is half solved." We restate our problem in several different ways until we are satisfied that we truly have the crux of our challenge in the final statement. Often this may be facilitated by asking, "Why?" in answer to one statement of the problem in order to obtain a fuller understanding of the real problem in the next restatement of it.

Thirdly, having broadened our problem statement until we are able to determine a specific aspect of it which we wish to attack, we embark upon idea-finding. At this stage we look for varied ideas or alternatives, tentative leads to a solution. This is the step in which we particularly apply the technique of brainstorming, or the principle of deferment of judgment. We strive for all alternatives, and by finding as many as possible we will probably be better satisfied with our solution than if we were to simply choose the first idea that would come to us, not bothering to look for more interesting or potentially better alternatives.

If you were judging a beauty contest and had only two candidates from which to choose, you might not be too happy with the decision you would be forced to make. But, if you had 50 candi-

dates from which to choose, the decision might be more difficult but you would probably be better satisfied with the ultimate choice. One of the basic premises of brainstorming is that quantity breeds quality. It has been found in the research that the more ideas you strive for, the more good ideas there are produced. Incidentally, it is usually found that the best ideas materialize during the latter half of the brainstorming session.

Now that we have many possible solutions from which to choose, the fourth step is the judgment of the most promising of these ideas. We may again brainstorm to determine which evaluation criteria we might consider as the yardsticks against which we may measure or judge our many ideas, and then choose those which seem most critical to the decision. When an idea fails to pass the test of a certain critical criterion, it is often advisable to make some modification of that idea immediately in order to make it more acceptable.

After judging all of the most potentially usable ideas against each of the most critical criteria, we are at the last step: implementation or acceptance-finding. This is the point at which we prepare a plan of action, when we decide what we might do with the idea (or ideas) we have chosen as the best in order to assure its (or their) success. When we send our children out into the world, we don't send them without some preparation. When we want an idea to be accepted as a solution to a problem, we don't simply toss it out on its own. We prepare it. We may alter or modify it to assure its being as acceptable as possible.

These, then, are the five basic steps of our creative problem-solving process. You may ask how this differs from any other kind of problem-solving. Generally, the differ-

ence lies in the application of the principle of deferring judgment at each step of the process until we have availed ourselves of all possible alternatives. Throughout the process, we alternate between imaginative thinking and judicial thinking, or what might be called divergent thinking as opposed to convergent thinking.

By imaginative or divergent thinking we mean going off in all directions, all ways possible; open-ended thinking. By judicial or convergent thinking, we mean narrowing in on a certain train of thought, in a particular direction, toward a certain solution.

We begin at the fact-finding step by filling the hopper with all the facts that we can obtain with regard to our object or situation to be resolved. Then, looking over all these facts, we narrow in on what we think are the most salient facts to lead us to a specific statement of our problem. We then diverge again, going in many directions by restating our problem in as many ways as possible, finally narrowing in on what we judge to be the best statement or the one aspect of it (and probably it will be a sub-problem of the broad, general problem) we wish to work on.

At the next step we again think imaginatively, going off in all directions possible, piling up all of the ideas that could be solutions to our problem, and then converge upon those which we feel have the greatest potential, to judge against each other. Again, we diverge to think of all the evaluative criteria against which we may measure these prospective solutions. After judging the chosen ideas against the most important criteria, we now imaginatively devise a plan of action by anticipating all the circumstances that could cause difficulties in putting our idea(s) to use. In doing

so, we are now confronted with a whole new challenge which we could state for ideation by asking, "In what ways might I assure acceptance of this chosen idea?" and we begin the process again.

Before leaving the description of the process, a bit more should be said about the brainstorming technique. No doubt you are familiar with this term which, with the methodology, was introduced some years ago by Alex F. Osborn, a co-founder of Batten, Barton, Durstine and Osborn (B,B,D & O). There has been some criticism of the technique, largely because of misunderstanding of its proper usage or application. It would be impossible to attempt a full discussion of it at this time, but an outline of the basic "rules" of brainstorming would be in order.

First, criticism is ruled out during the session. There is little which discourages creativity more promptly than a killer-phrase. Secondly, free wheeling is wanted. By this we mean that one idea should flow freely and quickly on the heels of another. We express each idea as it comes to us, deferring the judgment of it until after we have piled up all the ideas. We strive for the workable but allow the ridiculous if it arises.

As an example of this, we cite the case of the company that was making machine parts which had to be wrapped before they were shipped out. They found production was lagging because the workers were reading the newspapers used for wrapping. During a brainstorm session to see what could be done about this situation, someone suggested blindfolding the people. This seemed, pretty wild and ridicu-

lous, but eventually led to the idea of hiring blind people to do the wrapping.

Thirdly, as mentioned earlier, quantity is wanted. Quantity breeds quality. The more ideas you have, the more potential there is for good ideas. Finally, combination and improvement are sought. When one person mentions a certain idea, another person may take that idea and manipulate it in some way in order to evolve a different idea. A thought from one person may trigger an entirely different idea from another.

Now, let us return for a moment to the papers you wrote at the beginning of this session. We have discussed some of the techniques which we believe will help you nurture your own creativity: questioning habitual thought patterns, observing carefully through all of your senses, increasing mental effort, using checklists, looking at the chair from many points of view, not judging ideas immediately as they come to you, etc. You now have the information but it won't become a part of you until you use it.

The challenge to you now is: take your earlier list and in another three-minute period see how effectively you are able to put this information to your own use. See how widely you can go in your thinking, how loose and open you can be in your thinking, and then compare your first ideas with your new ones. Be constructively discontented. Probably none of you is actually going to change that chair, but as a short exercise in your own mental flexibility, take three minutes of your time to see how many really interesting ways you can now find for improving the chair.

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